the Illinois Technograph

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FEBRUARY, 1949

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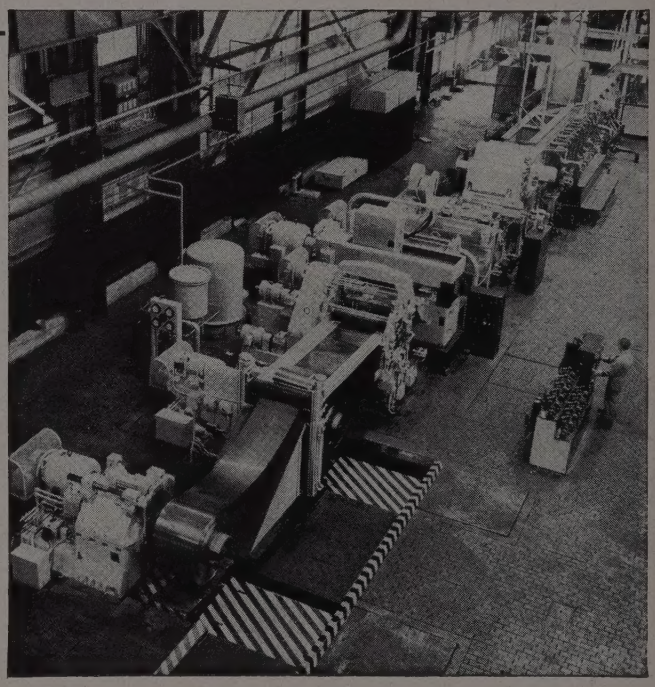
TWENTY-FIVE CENTS

Electrolytic tinning process stretches tin supply

—makes better, less expensive tin-plated products

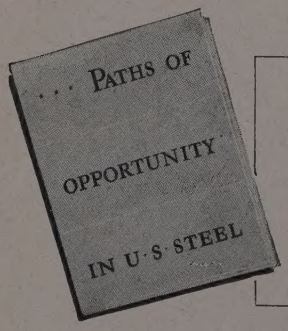
• pioneered by Carnegie-Illinois Steel Corporation



Before the war, almost all tin plate was made by the hot-dip method in which a sheet of steel was coated by dipping it into molten tin. In the 1930's, Carnegie-Illinois Steel Corporation, a member of the United States Steel family, played an important role in the research work and the technological development of the *electrolytic process*—an improved tinning method in which a strip of steel is given a thin, uniform coating of tin by passing continuously and rapidly through a bath of special plating solution. This process necessitated the development, by Carnegie-Illinois engineers, of complex mechanical equipment completely revolutionary in the industry.

Since the electrolytic process covers a given area of steel with only one-third the amount of tin that the hot-dip method requires, it makes the tin supply go 3 times as far.

Today, United States Steel Corporation has nine electrolytic tin-plating lines producing U·S·S Ferrostan. These lines are helping to lower the cost of tin-plated steel . . . stretch the supply of tin—and make better tin-plated products.



Opportunities

Work such as this has an important place in the operations of all U. S. Steel Subsidiaries. To be carried out successfully, these undertakings require qualified technical men. Why not see your Placement Officer about the book "Paths of Opportunity in U. S. Steel" and find out how you can take part in this interesting, important work?

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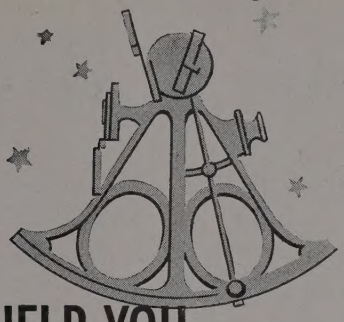

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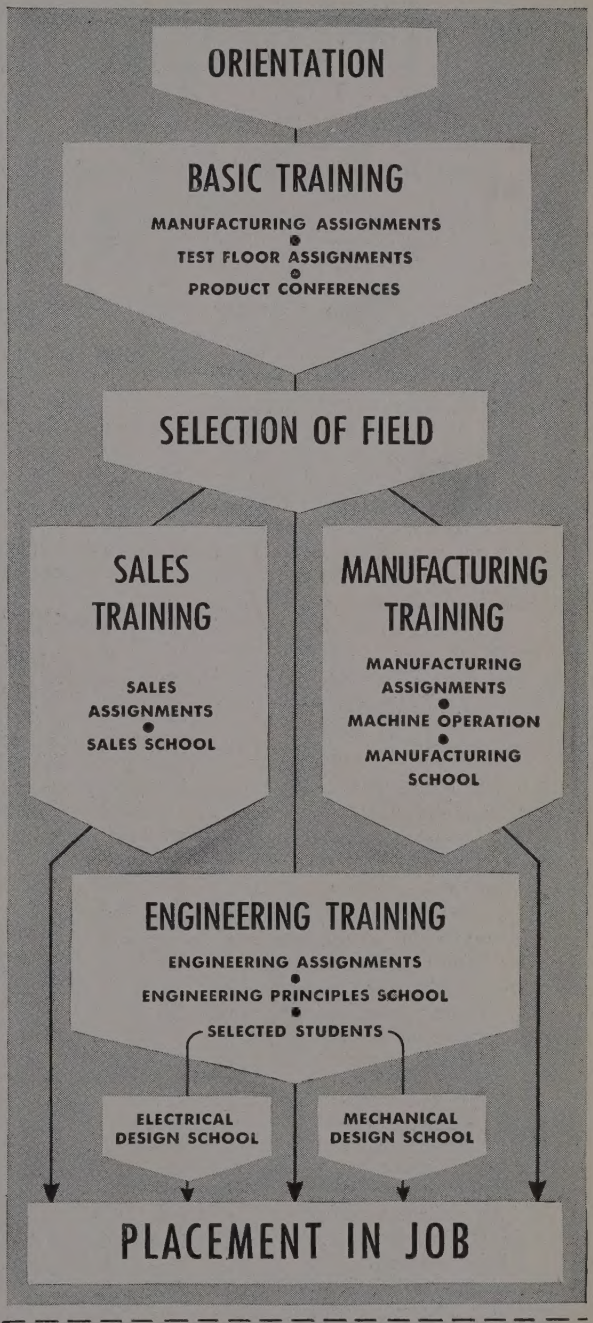
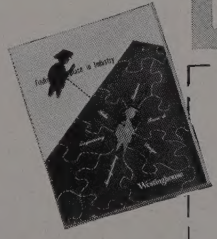


Get full particulars about the Graduate Student Training Course and the opportunities open to you at Westinghouse. Begin planning for your future today. Get your free copy of the booklet, "Finding Your Place in Industry".



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New Developments

By Leonard Ladof, E.E. '49
Ken McOwan, M.E. '49
Henry Kahn, Ch.E. '50

Winter Proof Highway

Another triumph for highway engineering will be realized with the new year when a snow-melting highway is opened for use in Klamath Falls, Ore.

The application of radiant heating principles to a public road will keep a four-lane highway clear and skid free in all weather. The heated road section is an eight per cent grade, 450 feet long, on the Dalles-California highway, leading into Klamath Falls from the north. Heat is supplied by hot water from an underground spring, circulated through a network of welded, wrought iron pipe laid in the concrete. Work was started on the road last spring after a 10-inch well had been drilled and a good flow of hot water tapped at a depth of 390 feet. A coil of two-inch pipe is submerged deep into the well, which acts as a boiler. A pump sends ordinary water and anti-freeze through the coil where the solution is heated to 160 degrees.

The pump, thermostatically controlled, begins to circulate the water when air temperature drops to freezing and continues to operate until the temperature rises above freezing. Another pump draws water from the well since it loses its heat value as the cool solution flows from the road through the transfer coil. Hot water then bubbles up from the earth back into the well. In continuous operation, the system is capable of melting one inch of snow per hour.

The New Look

In the future, when you admire the beautiful finish on refrigerators, washing machines, sinks, and other products finished in this manner, don't be too sure it is baked enamel.

A new finish called Superclad was developed by Sherwin-Williams engineers, because baked enamel can be applied only to a special steel. This new product, however, has the advantage of "sticking" to such metals as aluminum and low grade steels.

Superclad's chemical inertness is certainly a desired property, especially when it is to be used in industry. Tests on the synthetic enamel showed that it could withstand acids and alkalies up to eighteen months, while ordinary top-grade enamel succumbed within forty-eight hours.

F-M Radio for Railroads

Two-way radio communication as an aid to more efficient yard operation is now being used by the Illinois Central railroad. Station WMWK employs frequency modulation at 161.85 megacycles with a power of 15 watts. The reasonably effective range is about 15 miles.

The transmitter is located in the northbound "hump" office in the freight car classification yard at Markham, about 20 miles south of Chicago. The main communication is with the crews of switch engines engaged in making up the long lines of freight trains which roll down from the "hump."

High-Visibility Temperature Indicator

A new highly accurate temperature indicator can be read even under the worst conditions of visibility. This high degree of visibility is assured by contrasting colors between the background and the hands and numerals, a uniform scale, and shockproof and weatherproof construction, which eliminates fogging of the glass. In such construction, resetting of the maximum-temperature indicating hand cannot be accomplished by the usual knob protruding through the glass. Consequently the hand is reset by "wiping" a small magnet over the face of the cover glass. The magnet, which is screwed into a hub on the side of the instrument for safe keeping when not in use, is attached to a light chain to prevent loss. The temperature indicator can be furnished with an alarm contact that indicates when a pre-set temperature is reached. An oil-tight mounting will permit removal and re-installation of the unit without changing the oil level or disconnecting the transformer.

Automatic Flux Mapping Machine

The invisible field of force surrounding electrically charged pieces of metal can automatically be represented on a drawing board with a new instrument developed by the General Electric company. This field mapping instrument may be used to study such problems as the flow of heat in and around heated objects, the magnetic field surrounding from the rocket, the "chute" slows an atom-smasher magnet, and the twisting forces set up in propeller blades.

Field mapping up to this time has been a tedious process of calculation and point by point plotting of curves. This new instrument can map fields of any two-dimensional and many three-dimensional shapes in a few hours.

In operating the instrument, the metal boundaries are connected to a power supply and submerged in a shallow tank of water, which acts as a conductor of electricity. Three small probes, extending downward into the water like miniature fingers, are used to pick up the voltage which varies from place to place. These probes are suspended from mobile equipment above the water. The machine is built so that when the probes move, they follow a line of constant voltage. The motion of the probes is then reproduced on the drawing board by means of a four-foot-long metal arm. Only the center of the three probes actually follows the lines of constant voltage. The outside probes serve as guides which steer the center probe around the corners taken by this line.

The same process applies equally well to heat problems and to twisting forces in propeller blades. The lines of equal temperature or strain are equivalent to the constant voltage lines.

Supersonic Parachutes

The pilot of the future may safely escape from a disabled supersonic craft at high altitudes where an ordinary parachute would be useless. He would be enclosed in a bullet-shaped metal "capsule" with a propeller on its tip.

The device, also called a "rotochute" and developed by General Electric engineers, is now used in rocket research. At present the "rotochute" is capable of gently lowering delicate instruments to the ground from rockets flying as high as 100 miles. After being released gradually from supersonic speeds to about 27 miles per hour by means of its whirling propellers or vanes which act as an air brake.

Although not now intended for use by humans, the "rotochute" can be redesigned so that it could carry a pilot and could be fired by an explosive charge from the rocket. The pilot could then guide the course of the device by controlling the pitch of its vanes and could land with greater accuracy than is possible with a parachute.

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the Illinois Technograph

Volume 64 **Number 5**

The Tech Presents

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OUR COVER

Air view of the Northrop XP-79, highly unconventional twin-jet Flying Ram, in flight over Southern California. Features of the XP-79 are fully enclosed cabin and jet engines, prone-position for the pilot enabling sharper turns and pull-outs, and over 500 m.p.h. speed. (Photo courtesy of Aeronautical Engineering Review.)

'Engine' Students Take Note . . .

Early next month, a contest will be held to determine which instructors are considered, by vote of the students, the most effective in their teaching methods. The objectives of this contest, sponsored by the Engineering Council and the Illinois Technograph, are to promote an active interest in the advancement of effective teaching, to honor members of the faculty in each department of the College of Engineering, in particular, those who are chosen by vote of the students as the most effective teachers, and to bring about a closer relationship among the faculty and the students.

Here's how the contest will work:

1. Voting is open to all juniors and seniors in engineering.
2. Junior and senior engineers will cast three votes for their most effective instructors, no more than one vote being cast in any one department.
3. Voting will be for instructors in all engineering departments at the University, including chemical engineering and architectural engineering. For the purpose of this contest, mining and metallurgy are considered two separate departments. The departments to be included are as follows:

Aeronautical	Civil	Physics
Agricultural	Electrical	Mining
Architectural	G.E.D.	Theoretical and Applied Mechanics
Ceramics	Mechanical	
Chemical	Metallurgical	

4. The starting date of the contest will be Wednesday, March 16, and voting will continue until Friday, March 18.
5. Between the above dates you can cast your votes either at the special booth to be located outside Engineering Hall or at the ballot box in your respective departmental office.

Shortly after the close of this contest a special College of Engineering convocation will be held in the University auditorium. At that time the winners of the contest will be announced and a plaque, with their names inscribed, will be presented.

Below are listed some points which mark the good instructor. Before deciding who your most effective instructors are, consider these points carefully!

The good instructor . . .

Knows his subject thoroughly
Is interested in his field
Is orderly, systematic and careful
Is always prepared for class
Has definite standards of work
Gives assignments which are clear and varied
Gives tests that are fair and grades them accurately
Keeps the student informed of his standing

Remember to Cast Your Vote!

VOTING DAYS: MARCH 16 THRU 18, INCLUSIVE!

Can We Improve Technical Education?

By John Johnson, M.E. '51

Can we improve technical education? Certainly before the answer to such a question can be determined, an analysis of our teaching is in order.

Few people connected with technical education today, either in the capacity of administrators, teachers, or students are willing to say we have reached the ultimate in our teaching processes. Is it the ability of the teacher, the attitude of the student, or the process by which our teaching is done? Let us look at these factors separately.

Our Teachers

Are they educated men or are they teachers? Asking such a question indicates a belief that there is a distinct difference between knowledge and knowing how to teach. It is felt, with at least some justification, that too often a man is employed to teach on a basis other than his teaching ability.

To find the justification for such a statement, one has only to review the technical curricula of some of our representative institutions. This curricula, the only preparation many of our instructors have, in many cases shows a decided lack of courses on teaching methods. Such is not the case in non-technical curricula, for therein many education courses are offered; but in preparing to teach technical subjects, practically all the available time is spent in acquiring that technical knowledge which is to be imparted to others at a later time.

A frequently heard comment of students today is, "He knows his subject, but can't teach it." If such comments have basis, there must be requisites of a good teacher; requisites which some of our teachers in technical schools do not have. Let us enumerate but a few: (1) the technical knowledge, (2) the desire to teach and work with others, (3) the personality for teaching, (4) the ability to teach.

Before we discuss these factors, let us divide our present day faculties into two groups, which we may call the "stop-gap" and "normal" groups. Such classifications certainly overlap, and are not to indicate definite segregation.

The "stop-gap" group came into being as a result of the second world war. The return of thousands of veterans, along with the normal flow of high school graduates, presented an almost insatiable demand for instructors. Few colleges or universities in this country had sufficient faculties to handle the tremendous rush to college which took place at the close of the war. Additional teachers were required almost immediately; certainly more quickly than our normal process of training teachers could supply. What was the alternative?

This first-place winner of the recent Tau Beta Pi pledge competion treats a very worthy subject—education. By discussing the attitudes of teachers and students and analysing teaching methods, the author shows conclusively that there is much room for improvement in our present educational system.

The only apparent answer was to draft into the service of teaching those people who had finished undergraduate work, and who were remaining in school to work on advanced degrees. Many of these people had no desire to teach, but accepted employment as instructors as a means of partial support. Many, although technically trained, had no particular ability to teach. Some had personalities not conducive to instructing others.

A look at some of our great technical experts serves to prove there is a place for those who prefer to work alone. But how many of our great educators have been men whose best work was done in the confines of their own offices or laboratories? The need for the desire to teach and the personality for teaching seems apparent. It suffices to say that ability is essential.

Can we condemn this group who is teaching as a means to an end, who is using a faculty position as a stepping stone to an advanced degree? No, rather they are to be profoundly thanked for the service they are rendering. But as we approach the normal flow of students again, every effort should be made to reduce within appropriate limits, this group who have tried to combine teaching others with advanced studies of their own. Either seems to be a full-time job, with the result that a mixture of the two only dilutes the success of each.

The "normal" group includes those people who have chosen teaching as a career, are qualified technically, and have the ability and required personal traits to teach. This group is to include all those who do well the job of their choice. Obviously, an expansion of this category is desirable, but also difficult. Many men who could have potentially been great teachers are in industry today. The reason is economic. Today, many students feel sincerely that they would like teaching as a career, but are forced to pass the choice by, afraid of the economic shortcomings involved. Certainly, we have no right to expect men to enter the field of teaching, when that very entry means, in many cases, great financial loss. When and only when the people of this country are willing to "pay the price" for good teachers, through taxation or otherwise, can we expect this group to be expanded.

This so-called normal group, naturally includes good, fair, and poor teachers, but an expansion of this category would, by the normal process of competition, eliminate those not qualified for the job they chose, as is the case in any field.

Our Students

What student factors greatly affect the success of technical education? Probably the three most important are ability, aptitude, and attitude. The casualty rate in our technical schools indicates that too great a percentage do not have the ability to master technical subjects. In many cases, a lack of aptitude for the chosen curricula is evident. How about attitudes? Certainly they are not all that is to be desired in many cases. Let us examine each of these factors separately.

One possible cause of inability to master technical subjects lies in the lower level education of our students. It is very possible that students in high school delay too long the choice to study technical subjects, and hence fail to adequately prepare themselves for their college work. Many returning veterans have been unable to readjust themselves to the study processes required. At least some justification must be given the theory that many students enter college at too young an age to be fully capable of mastering technical subjects.

Little can be said about the lack of

(Continued on page 22)

JETS ARE JUMPING

By George Ricker, Aero.E. '49

As time follows time and man gathers new knowledge, startling and revolutionary creations are produced in the fields of industry. However, the advent of these new products is not wholly one of recent research but the growth of a feeble idea in the minds of ancient scientists. This is very true of the latest development in aeronautics—jets. The jets which are seen streaking across the sky today are reminders of a long research process which began before the birth of Christ and has continued up to the present day.

Hero, an Alexandrian philosopher, began this research by the construction of an aeolipile in 130 B.C. This aeolipile was a hollow sphere supported between two pillars. One of the pillars was hollow, and steam was transmitted through this pillar into the sphere. There were two jets located diametrically opposite of each other on the sphere, and as the steam was released through the jets, the sphere rotated on the pillars. However, at that time there was no explanation for this result, and the progress of jet propulsion was mired down for 18 centuries until Sir Isaac Newton introduced his third law of motion. This law, which states that for every action there is an equal and opposite reaction, was presented to the public in 1687, along with his other works, in a volume entitled *"Principia."* The explanation of jet reaction which this law provided brought about new enthusiasm. Scientists renewed the investigation of jet propulsion. The results of the experiments were not very encouraging though, and the most practical thing designed was a four-wheel "steam carriage" accredited to Gravesande. This carriage was propelled by releasing steam through a jet at the rear of the carriage.

By the middle of the 18th century another lull had developed in the field of jet reaction. This lull was not infringed upon until the beginning of the 20th century.

At the start of the 20th century the inventors began to focus their thoughts upon the use of jet reaction to propel aircraft. In 1903, Avery, an American, visioned a helicopter with steam jets at the tips of the blades to produce rotation. However, the steam plants were too heavy for this purpose, and a model was never made.

In 1908, Lorin, a French engineer, proposed a multi-cylinder construction or wing installation. The layout was an inline reciprocating engine with divergent nozzles attached in such a way that the pistons would force the exhaust through these nozzles. The unit was to use only jet reaction for propulsion and no power was taken off of the crankshaft. The mass of air handled by this power plant was inadequate, and the thrust obtained was far too small. Lorin had made a start in the right direction though, and inventors realized that the solution was a device which would increase the mass of air used and thus develop more thrust.

It is very possible that you have seen a jet plane streak across the sky and wondered about the development and operation of its revolutionary, jet propulsion engine.

This article presents the history of the jet engine and explains the operation of the four basic types of jets—the ram-jet, pulse-jet, radial flow turbo-jet, and axial flow turbo-jet.

In 1917 a Frenchman, Morize, proposed an "ejector" scheme which employed a convergent-divergent nozzle. An engine drove the compressor and a fuel pump. The fuel and compressed air were delivered to a combustion chamber and the combustion gases were discharged through the combustion chamber nozzle into the convergent-divergent ejector tube. This process utilized a large amount of air, and the thrust was increased. In the same year H. S. Harris, of Esher, devised a propulsive unit which employed two ejector tubes. However, Harris' ejector tubes were divergent-convergent nozzles, just the opposite of Morize's. Harris used an engine to run the compressor, but the fuel was sucked into the combustion chamber and the fuel pump was eliminated. No attempt was made to put either Morize's or Harris' units into an airplane.

In 1930, Whittle, a British airforce man, tried to get the British government interested in a jet unit composed of a radial compressor and a gas turbine which was used to run the compressor. The British refused it on the grounds that the practical difficulties were far too numerous.

From 1917 up to the middle of the 1930's the progress was slow and the work was still being done mostly as an individual interest.

The first nation to start a large-scale research program was Germany. In 1934 three German aircraft companies, Junkers, Heinkel, and B.M.W., were assigned the task of producing jet units to be used in the aircraft which Messersmidt, Junkers, and Heinkel were designing.

Two years later, in England, Whittle formed the Power Jet, Ltd., with hope of building a workable jet unit. The British government was still very unconcerned about the matter and did not offer Whittle any encouragement.

Later in that same year the Junkers company in Germany started the layout for the Jumo-004 jet unit.

Meanwhile, Whittle had been constructing his radial compressor jet, and in 1937 it was given the first test run. The results were very discouraging. There was still a great deal of work to be done on the compressor and the combustion chamber. However, the British Air Ministry was beginning to take an interest in Whittle's jet, and the construction of another unit was started immediately. This unit was completed in 1938. A test run of the second jet brought about severe damage to the unit. Therefore, Whittle began the design of another unit.

During this time the Heinkel company of Germany was finishing the research of the HeS-3 jet unit, and in 1939 this unit was installed in the He-178 airplane. On August 27, 1939, the He-178 took off for the world's first jet propelled flight. However, the HeS-3 unit developed less than 1,500 pounds of thrust and was not put into production. Junkers also finished the Jumo-004 in 1939 but it was not flight-tested until later. The Jumo-004 developed 1,760 pounds of thrust and had

better prospects than the Heinkel unit.

Meanwhile, Whittle was working hard on the WIX, his new jet unit. The WIX was finished in 1941 and was installed in the Gloster E-28 airplane. On May 15 of that same year, the Gloster E-28 made the first British jet propelled flight. By this time a large number of British aircraft companies were beginning designs for jet units.

In 1941, General H. H. Arnold of the U. S. Army Air Forces visited England and arranged to have one of the Whittle jet units shipped to America. The Americans were behind in the field of jets, and in order to speed up production of an American jet unit, the job of construction was given to the General Electric company whose personnel were experienced in turbosuperchargers. By 1942 the General Electric company had developed the I-A jet unit. During the construction of the I-A jet engine, the Bell Aircraft company designed and completed the XP-59A for the purpose of housing two of the I-A units. The jet units and the airplane were shipped to Muroc Lake, California, and assembled. On October 1, 1942, the XP-59A took off for the first jet propelled flight in America. The following year the General Electric company turned out the I-40 jet unit which was to be installed in the XP-80.

However, the Germans were still ahead in jet development, and in 1944 they commenced mass production of the Jumo-004B jet unit and the ME-262 aircraft. Late in 1944 the ME-262 was put into action against Allied bombers.

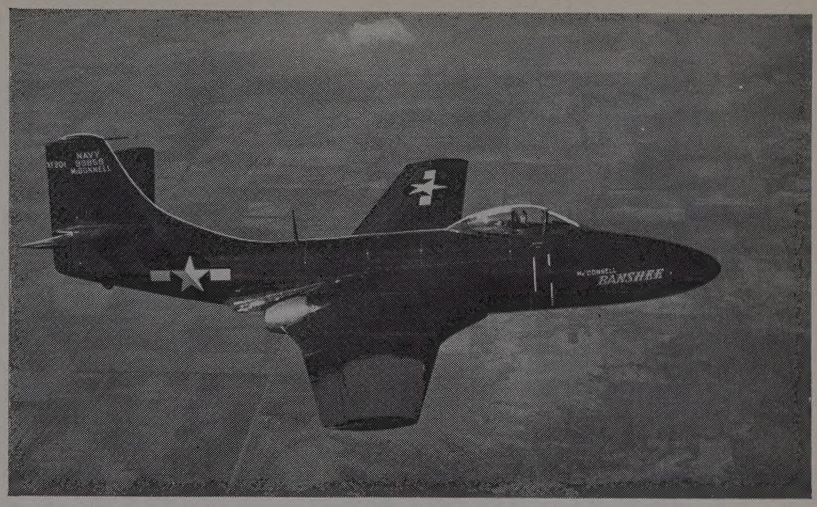
The Germans were defeated before they could do much more with jet propulsion, but the Americans and British have continued to improve jet engines and the planes which house these engines.

The jet propulsive units that are being built by the Americans and British can be cataloged into four divisions: rocket, pulse jet, ram jet, and turbo jet.

Although the rocket employs jet reaction for its propulsive power, it is somewhat different from the other jet units. The rocket is not an air-breathing unit; it carries its own oxygen or oxidizing agent along with its fuel. There are two types of rockets: (1) those which use solid fuel, and (2) those which use liquid fuel. The fuel is burned in a combustion chamber and the combustion gases are emitted through a nozzle at the rear of the rocket.

The rockets at the present time are used for assisted take-offs of aircraft and for guided and unguided missiles. One of the greatest handicaps of rockets today is the large amount of fuel which

(Continued on page 30)



The Xf2H1 Banshee was built for the U. S. Navy by McDonnell. (Photo Courtesy of Aero Digest.)

Wing tanks give the Republic P-84 Thunderjet a range of over 1000 miles. (Photo Courtesy of Flying.)

First A. A. F. fighter in the 600 m.p.h. speed class was the P-84. (Photo Courtesy of Aeronautical Engineering Review.)

Stepping Stones to Octane Numbers

By Wallace Hopper, M.E. '50

Whoops! Wait a minute! I looked again and drew to a stop just inside the south door of the mechanical engineering laboratory. What's this? An Ethyl Series 30 knock test engine! A glance at the name plate verified it. This very engine was one of the stepping stones in the story of the development of "octane number."

"Octane number" is a laboratory evaluation of the anti-knock quality of a fuel. Knock, or detonation, is that disagreeable little pinging sound which many drivers of cars hear when they are going up a hill, beating the other guy away from the stop sign, or passing another car. It is caused by the secondary self-ignition of the unburned portion of the charge in the cylinder because of the rapid rise in pressure and temperature following the primary firing.

Several factors combine to determine the degree of disgust which the driver may feel toward his car during the periods of knocking. These are (1) compression ratio, (2) jacket temperature, (3) spark advance, (4) air-fuel ratio, (5) speed, (6) combustion chamber design, (7) temperature of air-fuel mixture, and (8) fuel type.

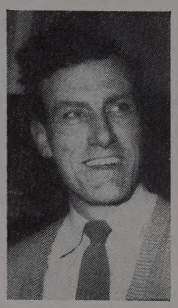
The phenomenon of detonation is common to internal-combustion engines used on the ground and in the air. In the aircraft engine, this characteristic is a very serious consideration, because it can rapidly produce a destructive condition at the piston.

Knock determination was an individual research problem among the industries in the eight years preceding 1928. Methods employed for establishing a relative knock rating for fuels were many; there is no absolute rating. One method, used by H. R. Ricardo, a British engineer, was to determine the compression ratio which would produce a light knock. This ratio was designated as the highest useful compression ratio (HUCR) of the fuel. The intensity was judged by aural means and was standardized periodically using a fuel of a given value.

Chemical analysis was attempted, as was power output and spark advance, in trying to evaluate the degree of knock; after much investigation along these lines, it became obvious that only an engine test could give the desired results. When using an engine, the only satisfactory substitute for the aural method is the "bouncing pin." Its essential parts are shown in Figure 2. As the pressure in the cylinder rises, due to the fuel combustion, it flexes the diaphragm which in turn allows an electrical contact, and a current flows. In the early development, the current went through an acid mixture, thus evolving a measurable amount of hydrogen. The pressure in the cylinder must be of the magnitude to produce knock before this takes place. Later, a knock meter was substituted for the hydrogen evolution process.

By 1928, it had become obvious that for marketing reasons some uniform method of knock determination had to be devised. With this in mind, the Co-operative Fuels Research committee, made up of members from the American Petroleum Institute, Society of Automotive Engineers, and The National Bureau of Standards, set up a sub-committee on detonation.

The sub-committee decided on three primary objectives as necessary to a standard test: (1) a test engine, (2) a scale of measurement, and (3) a reproducible method. Success culminated their efforts in 1932. During the intervening period, much work and thought had taken place; here is the niche which is partially filled by the Ethyl Series 30 engine.



WALLACE HOPPER

Wallace Hopper, one of the newest Technograph members, is a junior in mechanical engineering from Alton, Illinois.

Born on October 6, 1909, Wally has spent 18 of his years working in the petroleum industry. Fifteen of these years were devoted to anti-knock testing, which certainly qualifies him to write authoritatively on the subject of octane ratings.

Returning to school after such a long time in industry was surely a difficult but wise decision for Wally to make. However, after graduation he plans to return to his former occupation.

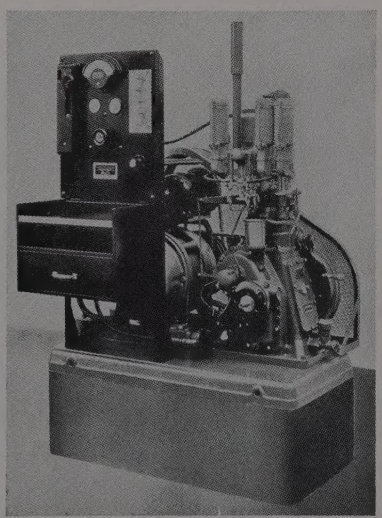
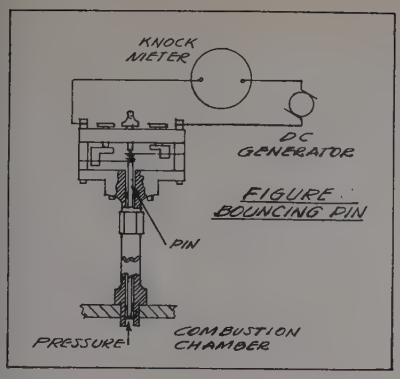


Fig. 1. C. F. R. engine tests motor fuels for knock characteristics of motor fuels.

The dictionary defines a stepping-stone as a means of progress or advancement. As such, the Ethyl Series 30 engine has a place among the many stepping-stones used in the development of the term "octane number." Octane number, although usually thought so, is not self-identifying. There are four types. This article points out the justification for the several types, the manner in which they differ, and the methods used to determine them.

It is interesting to note the important part the predecessor of this engine played in the development of the anti-knock compound tetra-ethyl lead. The unit was originally produced as a small lighting plant by C. F. Kettering of the General Motors corporation, but because of the hazards connected with gasoline storage, kerosene was considered as a fuel. Knocking and loss of power immediately followed the change of fuel.

It was thought, by analogy, that other engines must act similarly. So the search was on to find some substance which would raise the resistance of a fuel to knock. Thomas Midgley and T. A. Boyd, two veterans at knock research, were given the problem of finding the material. They did, after investigating 30,000 compounds. Tetra-ethyl lead, or more familiarly, lead, was the answer.



After considering several engines, the committee approved one which had been developed by the Waukesha Motor company, Waukesha, Wisconsin. This testing unit is shown in Figure 1. Basically, this engine has remained unchanged since its development. It is a single-cylinder, variable-compression unit, with overhead valves, and has 3¼-inch bore and 4½-inch stroke.

The next consideration, a scale of measurement, was answered by Dr. Graham Edgar, of Ethyl Gasoline corporation, who suggested the use of the pure chemicals iso-octane (2, 2, 4-trimethyl pentane) and normal heptane; the former being arbitrarily assigned the value of 100 and the latter 0. An "octane number" of a fuel was established as equal to the percentage of iso-octane in the normal heptane required to give knock intensity equal to that of the fuel under test, when run under the specified conditions of test and in the designated engine. These fuels are ideally suited for the purpose because they have similar physical properties and are unreactive to change in engine conditions.

Because of their cost, approximately $30 per gallon at that time, it was necessary to set up secondary standards for routine use. Of course, as in the case of the engine, these fuels were not immediately obvious, and it required considerable elimination of other possibilities before they were approved.

Finally, for complete success of the initial "mission," the method was defined. This original method, presently called the research method, although suffering minor changes through the years, is still a factor in determining fuel characteristics. Its features are outlined in Table 1.

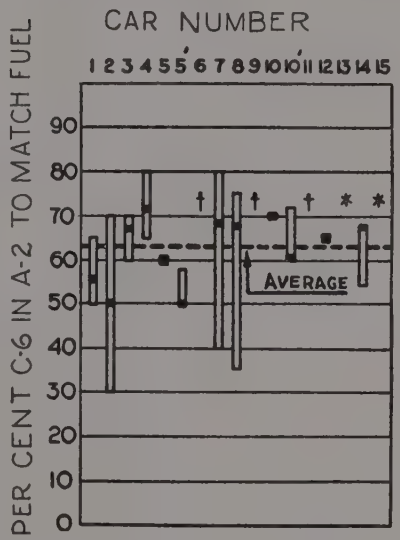


Fig. 3. Road knock ratings of one fuel are shown for several makes of cars.

The octane number of an unknown fuel is determined by putting the unknown fuel in one of three carburetors, setting the carburetor to the maximum knock mixture strength, and noting the meter reading. This reading is then bracketed with fuel blends of known octane values by putting them in the other two carburetors and adjusting for like conditions. An interpolation of the readings gives the equivalent rating of the unknown fuel.

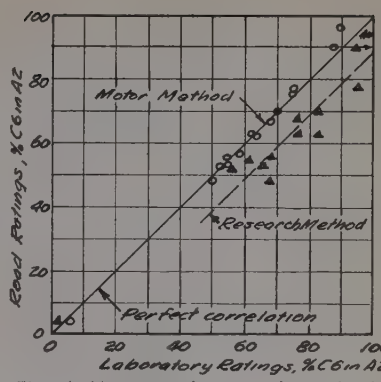


Fig. 4. Motor and research methods with the 1932 road tests are comparatively plotted.

The answer had been found so far as the laboratory measurement of knock was concerned, but another very important question arose. How would these laboratory results correlate with the knock as found in the car on the road? To solve this, a hill near Uniontown, Pennsylvania, was chosen in 1932 as a site for road tests, and representatives of 15 oil companies and automotive companies rated 15 fuels in several cars of different makes. These fuels were rated at the point of maximum knock encountered during the run up the hill. The results were interesting since knock is a function of compression ratio, air-fuel ratio, speed, spark advance, and air-fuel temperature, and no one of these is exactly the same in any two cars, or for that matter, in any two cylinders of a given car. Wide variations were found in rating the same fuel in the diffenent cars. Figure 3 shows how one fuel rated against the secondary reference fuels in use at that time. The extreme difference represented about five octane numbers. The reproducibility of the laboratory engine was ±0.5 octane number.

With road data in hand, the group tested the identical fuels by the research method at the Waukesha Motor company laboratory. The degree of correlation between the average road test and the laboratory ratings is shown in the Figure 4. On the basis of this work, a revision of the laboratory method was necessary. Additional investigation brought about the more severe motor method; its specifications are listed in Table 1. The usefulness of the two methods lies in the ability to determine the effect of engine conditions on a knock rating. The following table lists a few data by both methods.

(Continued on page 24)

Table 1— Operating Conditions for Laboratory Knock Test Methods[1]

Method	Speed, rpm	Spark adv., deg.	Jacket temp., F.	Humidity Int. air gr./lb.	Intake air F.	Fuel-air ratio	Comp. ratio	Determined by
A.S.T.M. D908-47T Research Method Formerly CRC F-1	600	13.0	212	25-50	125	max. knock	variable	bouncing pin
A.S.T.M. D357-47 Motor Method Formerly CRC F-2	900	Variable auto.	212	25-50	100 mixture 300	max. knock	variable	bouncing pin
A.S.T.M. D614-47T Formerly CRC F-3 Aviation Method Fuels of 70 O.N. or over at a lean fuel-air ratio	1200	35	374	25-50	125 mixture 220	max. thermo plug	variable	thermo-couple
A.S.T.M. D909-47T Formerly CRC F-4 Superch'ge Avia. Meth.	1800	45	375	70 max.	225	variable	7.0-1	aural
Fuels of 85 O.N. or over at knock limited power, under supercharge rich mixture conditions	Note: Fuel injection							

[1]See: 1947 Supplement to Book of A.S.T.M. Standards, Part III A, American Society for Testing Materials, Philadelphia, Pa., 1948

SALES ENGINEERING

By BERNARD LESTER

Sales Manager Westinghouse Electric Corporation

Sixty days ago the new plant for building pumps would have been a great place for an entertainment: walls glistening, floor big enough for a roller skating rink. But now the steady fluorescent light from the ceiling sheds its bright rays over long rows of machine tools, conveyors, and spotless work tables. Not only a safe, efficient layout, but a pleasing place to work.

It had all come about through the persistent skill of the works engineer and his crew, and sales engineers representing suppliers of machine tools, material handling equipment, and other suppliers of just the right apparatus for the job. Back of it all were the stockholders' dollars wisely spent by the folks up top for capital equipment. A building itself years ago was 90 per cent of the investment. But now the tables have turned. The "house," important enough, is designed to enclose a whole array of carefully engineered apparatus, many times its value.

Machines? Plenty of them. And here they were alive; all were selected and tailored for one particular job. Motion and power with infinite exactness all engineered to perform one particular duty: make high-grade pumps, efficiently and profitably.

In accomplishing such a result, the work of the sales engineer is seldom recognized. To the casual observer the credit for producing all this productive apparatus goes to the men at the supplier's headquarters who designed and built it, and to the people who own and run the plant where it is installed. But to the capable and resourceful sales engineer should go much of the credit for intelligence in putting the various tools to their proper use. His job is never done, until what he sells is properly engineered and in place, continually producing the full service for which it was intended.

Exactly what does this sales engineer representing the apparatus manufacturer do? He is an engineer, a practical economist, and a promotional force—these, all in one. He must know his customer's processes and problems and be able to solve them. He must know the design and construction and operating factors of what he sells. And too, he must know people, how their minds work, from the customer's engineers to the purchasing agent who places the order.

Sales engineering during recent years has jumped by leaps and bounds into a position of singular importance. Everyone knows the age in which we are living is becoming increasingly mechanical, but technical products are useless unless skillfully applied.

Saving the old horse and buggy with paint and repair no longer works. Machinery and equipment are on the move. There are better designs each year, with new operations to perform. Results come in the ever-expanding use of capital goods, through spending wisely, with a keen knowledge of depreciation and possible output and earning power.

With all this progress has come a great change in the art of selling productive equipment. Years ago the machinery salesman was a high-powered entertainer. For instance, he knew scarcely more about the power plant apparatus to be sold to the village than the city fathers themselves, as they accepted his entertainment and sometimes his graft. Sales engineering today is a serious job, requiring talents of a high order. Yet we still associate with selling the idea of persuasion to buy that which one may not actually need. Not so with the sales engineer. He does not grab the order and disappear. He must live with his customers year after year. He is the consultant, the expert on his line of equipment, the man who gets into the plant and works out the problem. Sometimes his recommendations are "not to buy" and often this advice creates a reputation that is worth its weight in gold for many years to come.

"Wanna buy a duck?" No, you wouldn't hear this phrase from a sales engineer. Sales engineering is a position of singular importance and requires the talents of a man familiar with many other aspects of life besides engineering.

Perhaps, up until this moment, you have had no concept of the various duties performed by the sales engineer. An excellent description of these duties is given in this article by Mr. Bernard Lester, a man of vast experience in this field, and who now holds a position as assistant industrial sales manager of Westinghouse Electric corporation.

Creative? No class of engineering service is more creative than that of the sales engineer. Of course he creates business for his employer. But materials are of little value in their native state. The value in the machine tools he sells, for instance, traced away back, is the work that has gone into the making of them.

Who could be more productive in creating work for his own company or for the plant that uses his machines, products, and services?

But sales engineering is creative also in another sense. Back in the black thirties, there was a run-down paper mill, antiquated, inefficient, tottering. The sales engineer of an important builder looked upon it with vision and with intelligent enthusiasm. He set to work. Nothing was further from the paper mill owner's mind than to buy. But the sales engineer had resourcefulness and ability. He studied the mill and its inactive layout. He drew sketches and developed a new possible productive layout, all reduced to figures of expenditures and resulting reduction in the production cost and price per ton of paper. He interested local bankers and consulted with other apparatus suppliers in lines parallel to his own, gaining their support. Finally, he developed a practical program of revamping, and the willingness to invest funds. The decision was made to go ahead, even in the poorest time. He got a substantial order for apparatus. Was he creative?

Numberless examples can support this same idea. In 1934, the steel mills rolled cold-rolled tin plate at a maximum speed of 400 feet per minute. Only five years later, in 1939, a mill was in operation producing this tin plate at a speed of 2,300 feet per minute. This remarkable improvement came about largely from the efforts of a sales engineer selling rolling-mill machinery and a sales engineer selling electrical equipment, both working in conjunction with the engineers connected with the steel mill.

Where do sales engineers come from? How are they trained? Some few capable men, likely older ones, never took

(Continued on page 20)

Introducing . . .

by Robert Lawrence, E. Physics '51
and James Ephgrave, E.E. '51

JOHN L. WESTENHAVER

Contrary to common belief, there are some engineers who have interests south of Green street. A good example is the editor of the 1948 Illio, John Westenhaver, a senior in electrical engineering.

Although born in Pittsburgh, John spent most of his life in LaGrange, Illinois, where he attended Fenwick high school. At Fenwick he was active in many affairs, including work on the newspaper and yearbook. In 1942 he moved to San Bernardino, California, where he now has his home.

After graduating from high school in 1942, John came to the University of Illinois. Both his father and mother were loyal Illini. His father, a consulting engineer, graduated from Illinois in 1918.

After one semester, John left for the Army Air Force. During most of his time in the service, he was a radar operator in the Pacific theater. In the fall of 1946, he returned to the University.

When he became editor of the Illio this year, John took on many varied duties. As editor, he decides on the organization and layout of the book. He also suggests and approves the design and art work. Under his personal supervision are the Illio "beauties" and "campus leaders" sections. Their contents remain secret until the day of publication. In addition, he must organize and train the staff to take over next year's Illio.

An estimate of the size of his job may be shown by the size of the Illio. Even though it has the reputation of being the world's largest college yearbook, this year's volume will contain 120 more pages than last year, and 100 more than the previous record holder. It is no wonder that the editor is a very busy young man.

JOHN WESTENHAVER

As well as working on the Illio, John has served as house manager and secretary of his fraternity, Phi Kappa Sigma. In addition, he has been secretary of Sachem and is now secretary-treasurer of Ma-Wan-Da. He is also a member of Skull and Crescent and A.I.E.E.-I.R.E.

John put in a plea for more men from north campus to work on the Illio and in other activities. He has certainly shown that it is possible for an engineer to take an active part in extracurricular affairs and still keep up his grades.

DR. HARRY G. DRICKAMER

In 1947 the American Institute of Chemical Engineers presented their junior award to a chemistry professor on this campus. The award went to Dr. Harry G. Drickamer, assistant professor of chemical engineering, for the best publications submitted of the previous three years' work.

Dr. Drickamer came to the University of Illinois in July, 1946, on a research assignment. In the fall he started teaching chemistry courses in both the graduate and undergraduate schools.

He was born in Cleveland, Ohio, and attended Shaw high school there. According to Dr. Drickamer, his life at high school went along rather smoothly. He was active on several committees and played football and baseball.

He enjoyed sports and continued to play football and baseball at Vanderbilt university; but he gave them up after the first year in order to devote more time to studies. He then attended the University of Indiana.

He spent three years at the University of Michigan and soon found himself in school activities again. This time he became president of his senior class, and served on a number of active committees.

He received his bachelor of science degree in June, 1941; and that summer, he went to work for the engineering research department at Michigan. In 1942 he went to Texas City, Texas, to work for the Pan American Refinery company. This job also included research and a design assignment of new units for making aviation gasoline and chemical petroleum. He earned his master's degree in 1942 and became a member of two government committees. They were the Aviation Gasoline Advisory committee and the Toulene Technical committee.

While still in Texas, he worked on his doctor's thesis. For the spring semester of 1946, he returned to Michigan to complete the requirements for his doctor's degree.

It was soon after he received his doctor's degree that he came to Illinois for his research work. He is now working on such experiments as the fluctuation of liquids, the kinetic theory of gases, and other critical phenomenon pertaining to gases and liquids.

DR. HARRY G. DRICKAMER

Dr. Drickamer is a member of five honorary fraternities. They are Phi Eta Sigma, Phi Kappa Phi, Phi Lambda Epsilon, Sigma Xi, and Tau Beta Pi. He was also counselor of the student chapter of the American Institute of Chemical Engineering last semester.

He is married, has two children, and lives in eastern Champaign. He enjoys a good round of golf whenever he has a spare moment, and finds relaxation from his work by maintaining a garden.

The tailor was selling his best friend a suit. "I'm telling you, Harry," he said, "that even your best friend won't recognize you in that suit! Just take a walk outside for a minute and get the feel of it."

Harry went out and returned a moment later. The tailor rushed up to him with a smile. "Good morning, stranger," he beamed, "what can I do for you?"

In This Corner... NAVY PIER

Our New Engineering Council

It's taken a long time, but after two semesters of pushing, our engineering societies finally have the ball rolling. Yes, we do have an Engineering council here at the Pier. The students have come to the conclusion that a council is necessary for greater cooperation and recognition of our engineering societies.

Ever since the first article appeared in the Technograph concerning an Engineering council at the Pier, many readers have approached us with the question, "What power will the council have?"

We'd like to clarify this question for our readers. The council was not designed primarily to have power, but rather, as the preamble of its constitution states, to bring about a closer relationship between all engineering societies, promote mutual benefits, and sponsor the annual St. Pat's ball and Engineering show.

The council is already making progress. Within the past three weeks, there have been three meetings, during which the council has ratified its constitution, made application for recognition, and is currently working on the St. Pat's affair. There are still many things to be ironed out. However, we have high hopes for this new organization. As of date, it represents approximately 50 per cent of our engineering enrollment. Certainly a council that represents such a large body must be very responsible to the latter. We hope the council realizes this responsibility, and in turn, we urge that the entire student body get behind the plan with all their support.

To the members of the Engineering council, we wish the best of luck and success in the hope that you will be truly representative of our large engineering student body.

Mr. Ogden Livermore presents Matrix awards to Siegmund Deutscher on the left and Richard Choronzy. (Photo by Groemling.)

First Awards Presented

By Robert Lessin, M.E. '51

The Navy Pier staff set a new precedent in holding its first "coffee and cake" meeting during December, just before the Christmas holiday.

The highlight of the meeting was the presenting of matrix awards to Siegmund Deutscher, retiring editor; Richard Choronzy, recently appointed editor; and John Fijolek, ace reporter. The awards were presented by Mr. Ogden Livermore, faculty adviser here at the Pier.

These awards are given by the Illini School of Journalism in conjunction with the Illini Publishing company. The awards are given to those staff members who have worked faithfully in behalf of the magazine for at least one year.

At the meeting, an informal discussion was held concerning sales and methods to improve them. Many new ideas and plans were brought forth and much consideration is currently being given to them. It was during this part of the meeting that the editorship of the Navy Pier staff was formally turned over to Richard Choronzy. At this

(Continued on page 28)

NAVY PIER STAFF

Richard Choronzy ..... *Asst. Editor*
Naomi Suloway ..... *Asst. Bus. Mgr.*

Editorial Associates

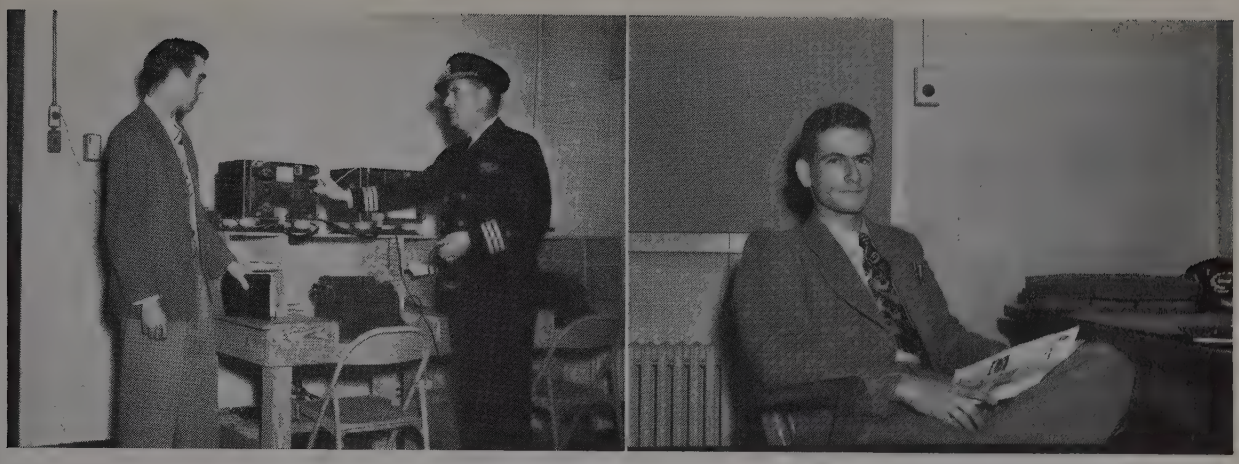
John Fijolek — Robert Lessin
Eugene Stojack — Richard Kawka

Business Associates

Robert King — Arthur Stanchurski
Clarence Niebow

Robert Groemling ..... *Photographer*

Enjoying the Pier Technograph staff meeting are, left to right, Robert Lessin, Naomi Suloway, Richard Choronzy, Siegmund Deutscher, Mr. Ogden Livermore, Robert King, and Richard Kawka. (Photo by Groemling). Officers and sponsor of the A.S.M.E. are, left to right, Frank Bartkowicz, Dick Swanburg, Prof. Arnold Cobb, Gordon Knudson, and Victor Swenson.



Mr. J. H. Johnston, as counselor of civil engineers, aids the students in their many problems. Commander M. J. Gabbraith, U.S.N.R., explains the up-to-date electronic equipment in the electronics laboratory to the author, Ewing Sharp.

Undercover at . . . GALESBURG

MR. J. H. JOHNSTON
By Dean R. Felton, C.E. '51

A rather young instructor who looks more like a student than the average student does himself, is one's first impression of Mr. J. H. Johnston. This impression is very effectively erased though, when Mr. Johnston conducts a class and painstakingly leads his students through the bewildering maze of theoretical and applied mechanics and surveying.

A graduate of the Thayer School of Engineering at Dartmouth, he received his B.S. degree in civil engineering as a member of the class of 1946. His experience is not limited strictly to books, even though a recent graduate, but also consists of an understanding gained as a junior engineer with a Los Angeles engineering firm and in work at the Point Mugar, California, guided missile test center.

Commissioned an ensign in the U. S. Navy, he served for four years and five months as an officer in the civil engineer corps. In this capacity he held positions as maintenance officer at the seabee center, Port Hueneme, California, and as assistant training officer at Camp Rousseau, and also at Port Hueneme. His naval records show him to be a sea going officer as well, with time served aboard the U.S.S. Cleveland.

Mr. Johnston's most recent contact with a civilian engineering project was as a special engineer on the Matilija dam in Ventura county, California. A Recent development, this project encountered difficulty with the foundation material on which the dam was constructed. As an engineer on Matilija, Mr. Johnston aided in special grouting operations and helped conduct tests where-by compressed air was forced into grouting holes and resulting blow holes reported. This indicated faults in the underlying strata. This portion of his experience makes available to this aspiring civil engineer, knowledge which will be of great value to him in his future operations.

The University of Illinois is Mr. Johnston's first position as a college instructor. He came to Galesburg in April of 1948 and has since taught T.A.M. 150 and T.A.M. 211 as well as his classes in surveying. As an adviser to the civil engineering students enrolled here at Galesburg, he performs an important service. His knowledge of the industrial applications of the subject matter taught in school aid the young engineer in choosing the proper courses for his particular speciality.

NAVAL ELECTRONICS

The effectiveness of any organization depends largely upon the technical skill, efficiency, and close teamwork of its members. In industry, mass production demands a large number of trained engineers, technicians, and skilled maintenance men. The same is true for a military organization. It need not be stressed that the operation and maintenance of modern warfare units must be thoroughly understood by members of the military. Before the armed forces of the United States could wage an effective war with the equipment that the vast industrial forces provided, it was necessary to train and instruct a large number of inexperienced recruits in the use of modern military equipment. This was a tremendous undertaking, for most of the equipment was completely unfamiliar to many men who had no previous mechanical experience.

The large expenses involved in maintaining a regular army makes it impractical to keep a large standing army in times of peace. However, with world conditions such as they are at present, the government has decided that a large reserve force, subject to immediate service in case of emergency, is necessary.

The program of building this reserve force of trained men is carried out by the Army and Navy through various training units established in all parts of the United States. A particular example of such a training unit is the Naval Reserve Electronics Warfare company established by the commandant of the Ninth Naval district at the Galesburg division of the University of Illinois in the spring of 1948.

(Continued on page 38)

GALESBURG STAFF
H. Roy Johnson.....*Asst. Editor*
Reporting
Stanley Runyon Dean R. Felton
Luther S. Peterson
Photography
Joe Graham
Omar Estes, *Faculty Adviser*

BUSINESS STAFF
Dwight R. Beard.....*Asst. Bus. Mgr.*
Ewing Sharp.....*Advertising*

The Engineering Honoraries and Societies

By Bill Soderstrum, Cer.E. '52

Engineering Council

The Engineering Council, re-activated only three semesters ago, now consists of representatives from 12 engineering societies. The newest members of the Council are S.A.E. and A.F.S.

Plans for this year's St. Pat's Ball, to be held on March 5, are nearing completion. The Queen's crown is already made, and all member societies are working diligently on the displays that will border Huff gymnasium durin the dance.

Copies of a streamlined constitution, the result of many weeks of effort, were distributed at the meeting of January 12. This new constitution contains provisions to enable the council to function more quickly and effectively. The following officers were elected at this meeting: Carl Falk, president; Stanley Burnham, vice-president; Earl Moss, secretary; and Francis Sexton, treasurer.

A.S.C.E.

The student members of the American Society of Civil Engineers were honored at a joint dinner meeting with the Central Illinois section of A.S.C.E. The meeting was held at Latzer hall on December 7. Other guests were members of I.S.P.E.

Mr. Alex Van Pragg, Jr., president of the National Society of Professional Engineers, spoke on "Professional Engineering Societies." Mr. Van Pragg, also a member of A.S.C.E., is a member of the consulting engineering firm of Warren and Van Pragg of Decatur, Illinois.

M.I.S.

Distinguished guests of 75 mining and metallurgical engineers at the December 8 meeting of the M.I.S. were Mr. George S. Mican and Mr. John W. King of the Carnegie Illinois Steel corporation. Mr. Mican, superintendent of the South Works rolling mill, spoke to the members about the fundamentals of rolling practice. He accompanied his talk with several slides on the subject and afterwards held a discussion with the various members answering any questions which they had.

An election was also held at this time, and the officers chosen were Edward Sperr, president; Norbert Blaski, vice president; and Beverly Solliday, secretary.

TAU BETA PI

The ultra elite of engineering honoraries, Tau Beta Pi, held its initiation banquet at Hotel Tilden Hall on December 9, 1948. Prior to the initiation, President R. B. Carlson and Vice President J. W. Crawford were introduced to the group.

The speaker for the evening was Dr. Robert Dubin who spoke on expectations in industry as contrasted with reality. Dr. Dubin obtained his Ph.D. at the University of Chicago and now has a joint appointment at the University of Illinois from the department of sociology and the institute of labor-management relations.

I.T.E.

A curriculum for undergraduate civil engineers in traffic engineering was drafted recently by members of I.T.E. This curriculum should prove extremely helpful to future traffic engineers.

At the November 30 meeting, the I.T.E.s also laid plans for a field trip to the Chicago area this spring.

Nominations for this semester's officers were made at the December 14 meeting. Also at that time, the semester plans were brought to completion. The final meeting of the semester was held Tuesday, January 11. It was a dinner meeting at which State Traffic Engineer H. H. Harrison was the speaker.

I.E.S.

Mr. Dan Dunne was the guest speaker at the December 8 meeting of I.E.S. held at 319 Gregory hall. Mr. Dunne addressed 50 members on the subject, "What to Expect After Graduation" pertaining to the illumination field. Mr. Dunne is sales manager for Lighting Products Incorporated of Highland Park, Illinois, and chairman of the papers committee of the I.E.S. Chicago section. He has had a great deal of experience in lighting applications and sales engineering. His sales work has taken him all over the country, thus enabling him to compile information concerning employment in the illumination field.

During the business meeting it was decided to back the Senior banquet of the electrical engineers.

A.I.E.E.-I.R.E.

The electron chasers held their December 7 meeting at 100 Gregory hall. Carl G. Miller, sales engineer for Weston Electrical Instruments corporation, gave a lecture-demonstration on electrical instruments to 100 members of the A.I.E.E.-I.R.E. Mr. Miller exhibited several of the instruments to the audience.

During the business meeting, Charles Eletson, chairman of the field trip committee, announced plans for the field trip, which was taken January 6, 1949. The trip was to the Mallory Electric company of Indianapolis, Indiana. This company manufactures a large number of radio parts. The tour included inspection of the processes involved in the manufacture of capacitors, potentiometers, vibrators, and high-current contacts.

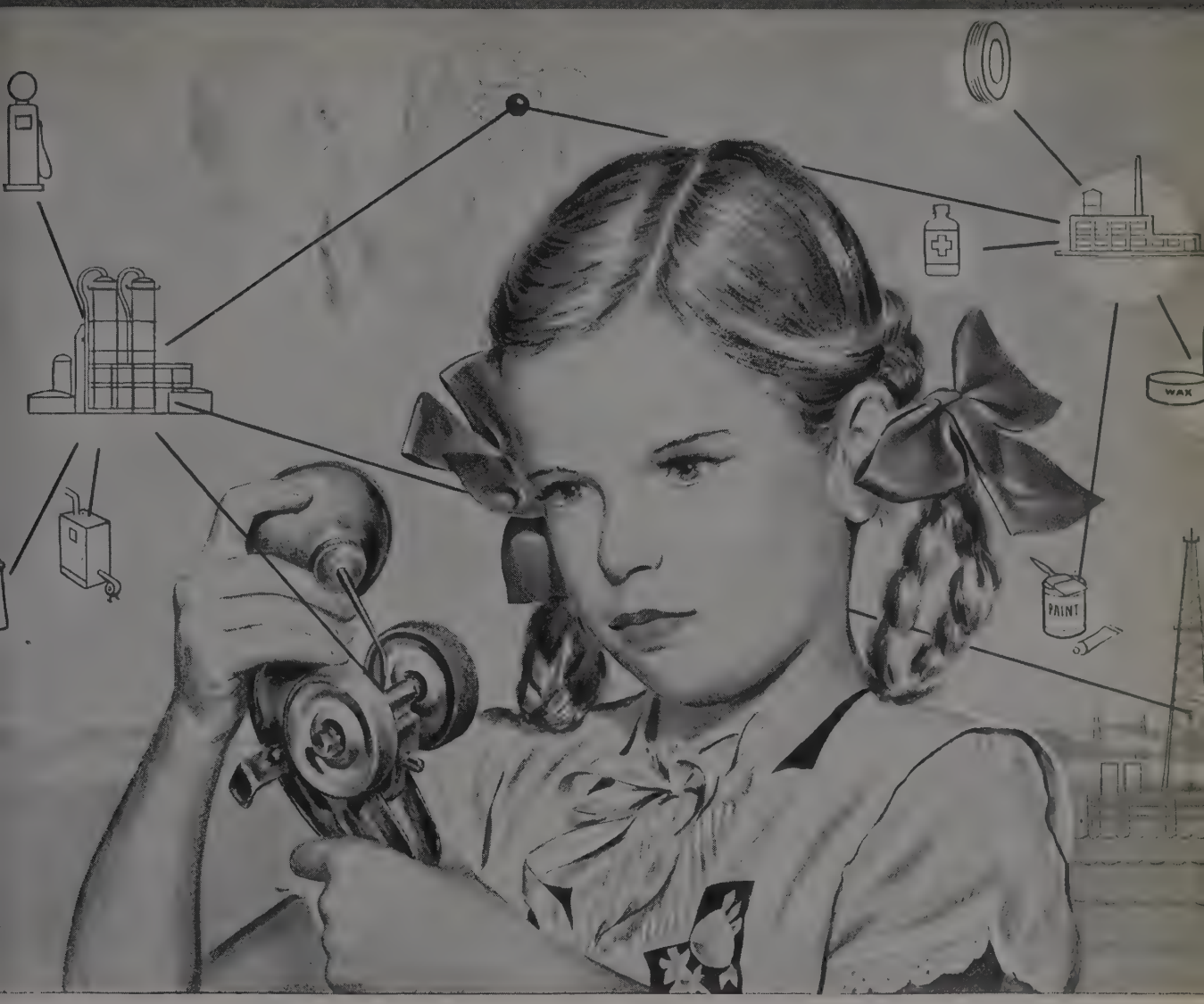
ETA KAPPA NU

The brilliant sparks (Eta Kappa Nu to you) held their December luncheon at the University club on the sixth of that month. At that time they heard an address by Dr. Louis Ridenour, dean of the Graduate college, who spoke on "The Second Industrial Revolution." Dean Ridenour briefly discussed possible unemployment due to "push-button" mechanization of industry.

Wednesday evening, December 15, Eta Kappa Nu held its semi-annual initiation and banquet. Dr. R. G. Bone, head of the Division of Special Services for War Veterans, was the guest speaker. Approximately 75 graduates and undergraduates were initiated at this meeting.

(Continued on page 26)

"—*The seeds of godlike power are in us still*"—MATTHEW ARNOLD



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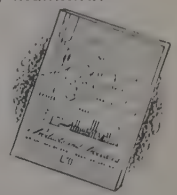

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EDWIN A. WITORT
Editor

•

PHILLIP B. DOLL
Assoc. Editor

the Illinois Technograph

What Happened to the Inspection Trip?

After registering for the inspection trip last semester, the senior class of the College of Engieering was looking forward to a pleasant and educational four days of visiting various industrial plants. Less than two weeks after registration, the senior class was informed that the trip had been cancelled.

During the war, security reasons were responsible for cancellation of the inspection trip; immediately after the war, hotel accomodations were unavailable; last year, with the return to normalcy, it was agreed by the faculty that the inspection trip should again be a requirement for graduation. A representative poll of the students taken last spring showed that they too, were in favor of the trip.

As a result of these favorable conditions, several members of the various departments of the College of Engineering, during the summer interim, proceded to make arrangements for the inspection trip. Companies were contacted, the date was set, hotel reservations and special train arrangements were made, and the entire plan completed before the start of last semester.

Shortly after registration was completed, the same companies were contacted and informed that plans for the inspection trip had been abandoned; hotel reservations and special train arrangements were cancelled.

The reason for this action, reportedly, is that a large number of veterans found it financially impossible to make the trip. Complaints were heard from all corners. The administration ceded to the wish of its veteran students by cancelling the trip and graduation requirements for the trip.

It is erroneously thought by a great number of persons that the Veteran's Administration was indirectly responsible for having the trip cancelled, because the VA would not finance the trip. This is not true. The VA will finance all expenses incurred by veterans in pursuing a required course of the College. Expenses for the inspection trip would include travel, subsistence, and hotel accomodations. The VA will pay for travel expenses, but refuses to reimburse veterans for subsistence and hotel accomodations on the basis that these are covered by the monthly allowances paid to veterans. This certainly is a justifiable stand.

The College of Engineering was too lenient last semester in cancelling the inspection trip because a number of veterans were unable to meet the required expense. There will always be students, veterans and non-veterans alike, who will express disapproval of a trip of this type because of the expense involved. The College of Engineering should realize this and proceed to make arrangements for such cases. Waiver of the required credit or petitions by students for this credit could be arranged to handle the hardship cases.

Many instructors feel that the opportunity afforded a student by these inspection trips will never present itself, once the student leaves school. The reason is obvious. An industrial concern makes adequate and elaborate preparations for a tour and inspection of its plants for occasions of this sort. Especially appropriate arrangements are made which are practically "tailor made" for senior student engineers. Special features are included and fine points are brought to the surface which would not be included in a tour of the same company by some other inspection party.

Several of the various departments of the College did schedule regular inspection trips or field tours when they were informed that the original plan was cancelled. These trips were certainly good substitutes, but not as effective as the original plan.

Freshmen, sophomores, and particularly juniors, should see to it, as soon as possible, that the inspection trip is again made a requirement for graduation. Plans for next year's trip will have to be made this summer. It might be well for the presidents of each society, as representatives of students, to express the existing enthusiasm about the trip to the heads of their respective departments.

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In total, their developments are the reason why telephone service here is the best in the world—the reason why it remains low in cost.

BELL TELEPHONE SYSTEM

SALES ENGINEERING . . .

(Continued from page 12)

an engineering degree. Most manufacturers of machinery, as well as of special products to be technically applied as alloys, lubricants and chemicals, take on from the technical schools each year a number of engineering graduates for training. Larger companies can establish definite and thorough training courses. With many of the smaller companies, the boy is simply put to work to learn the business.

Though the work of the sales engineer is an art, back of it stands science. It is a science based upon a knowledge of business organization, markets, distribution methods, and an understanding of group and individual human effort. More and more the heads and executive staff of manufacturing and operating companies are now drawn from the ranks of sales engineers.

Thirty or forty per cent of engineering graduates within a few years are engaged in work that is largely commercial in nature. The various courses in salesmanship—so commonly given in almost any important city—are often of little significance to the sales engineer, for they concentrate on merchandise and commodity selling. The fundamental training most needed by the prospective sales engineer is a combination of technical training and business training—the latter dealing with capital investment for technical accomplishment. The sales engineer must have one eye well trained to engineering, and the other trained to detect values and economic results. He must possess not only technical skill, but an understanding of where the use of his technical skill is leading us.

Salesmen and salesmenship are often frowned upon in academic circles—too close to the peddler or slap-the-back promoter. Because the sales engineer sells, he is often mentally catalogued as a pronounced extrovert. Unfortunately too few of us have had a chance to meet a mature, friendly individual selling machinery, foundry equipment, power plant equipment, or a host of other classes of equipment or highly technical products, and to watch him exercise an ability quite his own, comprehending a whole system of specialized production. His tools of accomplishment are in his head crammed full of experience.

The great need today in technical accomplishment is an understanding of where the invention, the new design, the improved process, the new material, will lead us, quite apart from the skill to create it physically. Sales engineers can lend a vision to Management, for they can be skilled in detecting the overall result, whether it be mechanical, economical, or social. They can give the "why" so greatly needed today, to guide the "do."

Although the sales engineer is the mouthpiece for the company he represents, he is also the eye which detects customer's needs. He is the one who can point to improvements. He can guide the designer in the character of the apparatus built. He often points to new items which his company might build, and provides the necessary spark to accomplishment.

The barometer of business activity points to various conditions at different times. Only about one-quarter of the time is the emphasis on production—times when the plans are loaded and the chief problem is to produce. The remainder of the years, plants are not working up to capacity, and the pressure is on distribution—not production. Today, when we are still wriggling out of the harness of war, the importance of distribution is coming to the front again with alarming force, and the sales engineer is taking his place at the head of the parade.

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Beginning a Career in Engineering

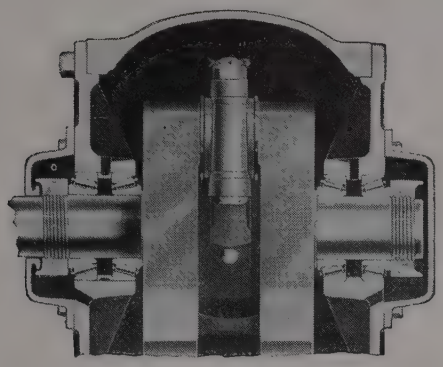
An article written expressly for the graduating seniors. What factors should be taken into consideration when selecting a job after graduation.

• •

Part two of

"Know Your Automobile"

Another page for **YOUR BEARING NOTEBOOK**



SH-H-H! A quieting thought for compressors

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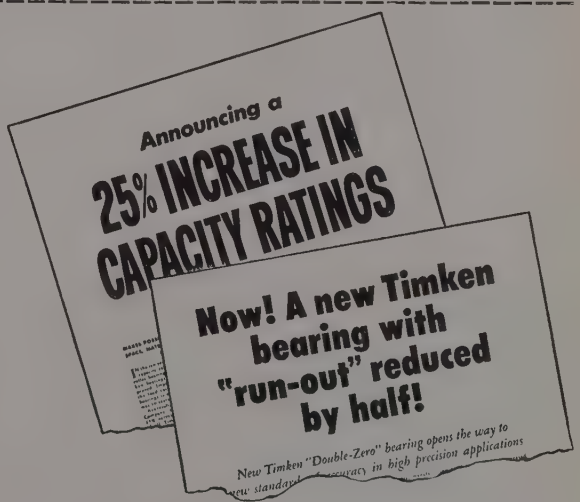
Two great developments have been announced recently by The Timken Roller Bearing Company. First, the capacity ratings of all Timken bearings have been increased 25%, enabling engineers to use smaller bearings, with savings in bearing cost, material cost and weight.

Second, the new Timken "Double-Zero" bearing —twice as accurate as any previously made—opens the way to new, higher standards of precision. These are the two latest examples of the Timken Company's well-known leadership in bearing manufacture.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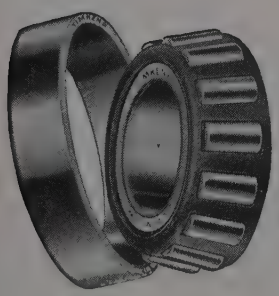

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CAN WE IMPROVE . . .

(Continued from page 7)

aptitude for chosen courses of study, except that this lack of aptitude must, by some system, be discovered before the student has wasted his own time and that of others, merely to find he is not suited.

Poor attitudes can be traced to several factors. First, a feeling that the best possible instruction is not being received breeds discontent. Second, poor prior showings in some subjects definitely foster belligerent attitudes on the part of the student. The conversion from war to peace-time and the accompanying disillusion doesn't make for the ideal attitude.

Rather than seek individual corrective actions for these factors, let us mention but a few possible improvements obvious to everyone, but slow in coming forth, which will aid in correcting all three factors.

Aptitude tests in the high school senior year would certainly catch many cases. At present, the tests are brought to light by the blunt force of failure. Screening tests upon entering college would tend to sort out those not capable of mastering technical subjects. Preparatory schools could, in short periods of time, prepare these screened individuals for the proper approach to a technical education. Possibly the greatest single boon would be a five-year technical program, rather than the current four. The additional year could tend to decelerate the program, which admittedly now progresses too quickly for adequate instruction. Part of the additional year could be used for non-technical subjects, a definite aid to better understanding and attitudes. Also, in the additional year, provision could be made for courses in teaching methods, indicated so sorely lacking. Many students who cannot master their subjects at the present pace, would have enhanced chances if the program was decelerated and spread over an additional year. Certainly any combination of these improvements should be welcome in our present system.

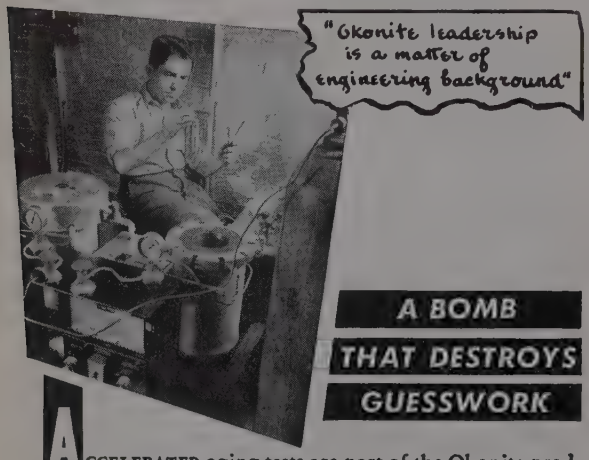
Our Methods

Are they the best possible ones? Probably one of our greatest shortcomings is the lack of necessary laboratory equipment, a condition due to wartime restrictions on production and to budget problems. Normal reconversion should partially alleviate this situation. Nor do our lecture rooms seem to be equipped with sufficient training aids, particularly in the form of visual aids. Blackboard recitations, though proven they are, are almost non-existent today. Does the instructor sufficiently prepare the lesson? How well is the material presented? Do examinations cover the material to be mastered? Is there sufficient discussion of the examinations? In spite of its many shortcomings, the Army theory of teaching might well be revived by our technical training institutions. The six-step method of preparation, explanation, demonstration, application, examination, and discussion certainly has worthwhile points to offer.

In view of what has gone before, the answer to our opening question is obviously yes. The correction of the existing conditions will necessarily be a slow and tedious process, for many factors, economic and physiological, are involved. But only when the teaching profession is made more attractive, when students are suitably prepared, when our colleges and universities are better equipped, will we even approximate the ultimate in technical education.

Jack: "Grandpa, we've been having an argument about whether the clock stands or sits on the mantel."

Grandpa: "It's half-past eight by the clock and it is only a quarter to eight actually; therefore, I should say it lies on the mantel."



A BOMB THAT DESTROYS GUESSWORK

ACCELERATED aging tests are part of the Okonite product improvement program. While they cannot replace the study of actual exposure to weather in proving ground and in the field, they have a definite place in estimating the value of electrical insulation.

The oxygen bomb shown at the left is used in accelerated aging tests — one piece of apparatus among many other examples of modern equipment at the service of Okonite engineers and technicians in taking the guesswork out of the manufacture of insulated wires and cables. The Okonite Company, Passaic, New Jersey.

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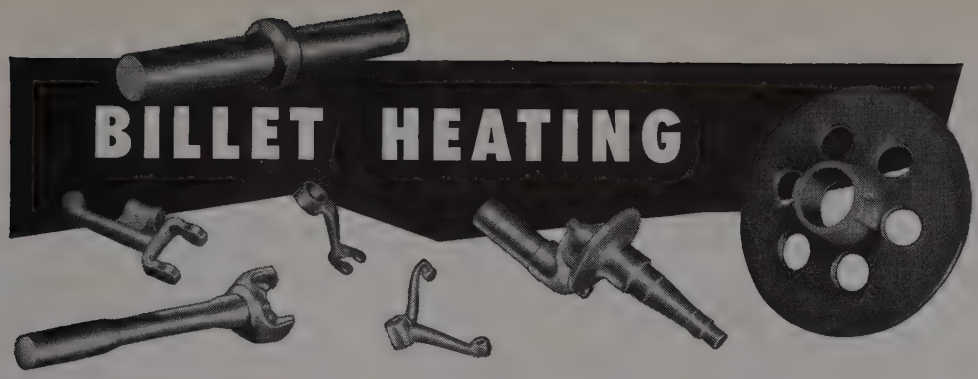

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Emphasize Speed of GAS

SPEED HEATING of small billets for drop forging demonstrates the speed of GAS for production-line operations requiring a flexible, controllable fuel.

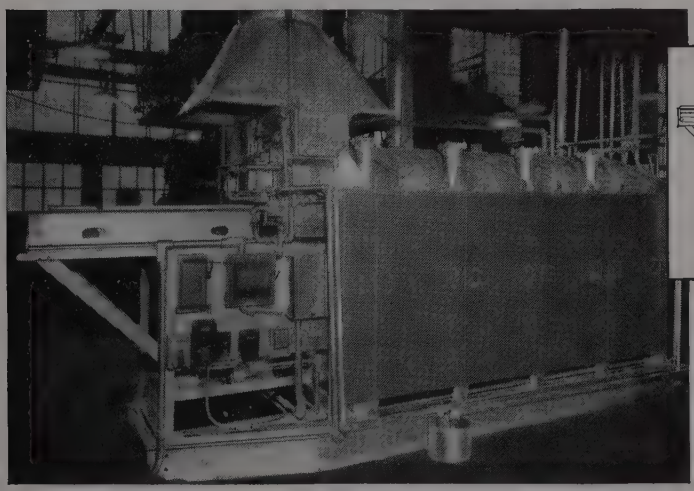
Drop Forge Division engineers and metallurgists, working with the furnace manufacturers, devised a simple Gas-fired, continuous-cycle billet furnace with the following characteristics and capabilities:

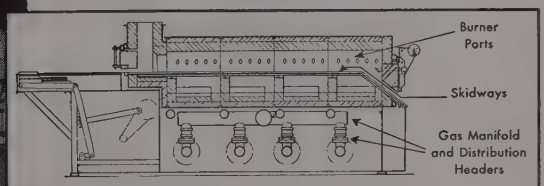
- **Billet Temperatures—2,200°-2,300°F**
- **Billet Heating Time—4 minutes normal (can be regulated as required in production schedules)**
- **Billet Discharge Rate—440 per hour, on 4-minute cycle**
- **Piece Dimensions (Average)—1"-2.5" thickness or diameter for rounds, squares, or flats up to 10" in length**
- **Furnace Heat-up Time—2,500°F in 15 minutes after initial lighting**

Quite as important as the productive capacity of the furnace are results of high-speed billet heating with GAS—

- **Uniform temperature of billets improves workability in forge**
- **Reduced scale minimizes abrasion in dies**
- **Flexibility for different sizes and shapes without costly equipment changes**
- **Economy of operation, of fuel costs, and of equipment investment**

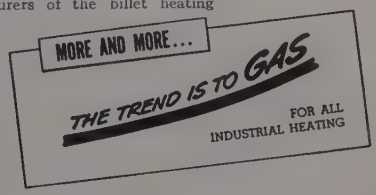
This application of modern Gas Equipment in an important production-line process is just one of the contributions made by GAS to industrial progress. There are many other heat-processing operations such as annealing, normalizing, stress-relieving, case-hardening, in which the productive flames of GAS have established records for productioneering. They're worth investigating.





Longitudinal section thru billet heating furnace shows simplicity of equipment

Section Drawing courtesy of Surface Combustion Corporation, Toledo, Ohio, manufacturers of the billet heating furnace.



AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE NEW YORK 17, N.Y.

STEPPING STONES . . .

(Continued from page 11)

In 1933, the American Society for Testing Materials adopted the motor method as tentative.

It was thought that the new method should be tested directly against some road data, so a new road test was carried out in 1934 on current model cars. The correlation was substantiated, as is shown in Figure 4. Again, in 1939, the motor method was put to trial by running a road test program; again it proved itself by giving a good correlation with the average road rating. Both motor and research methods are now recognized as laboratory tests for motor fuels, the motor for routine testing, and the research for what its name implies.

Table 2—Fuel Rating by the Motor and Research Methods

Fuel	Octane Numbers: Motor Method	Research Method
Iso-octane	100.0	100.0
Fuel A	82.0	93.5
Fuel B	80.0	82.0
Fuel C	73.0	82.5
Fuel D	71.0	71.5
Normal Heptane	00.0	00.0

Although, during the period just described, the emphasis was on motor fuels, there also was an interest in aviation fuels. In an aircraft engine, the fuel may knock, but most flyers have slight interest in this characteristic. The appearance of this condition, concomitant with overheating, can be rapidly destructive to pistons and cylinders, which is infinitely more important than noise. Because of the predominant importance of the engine temperatures, aviation fuels are rated for lean mixtures using a thermocouple and a potentiometer.

Until the war period, when the major portion of aircraft engines required fuels below 100 octane number, the rating was determined by bracketing the unknown fuel temperature with known blends of iso-octane and normal heptane and interpolating. Special conditions were used for this aviation test, and these are listed in Table 1. This is known as A.S.T.M. Method D614-47T.

With the war, however, came the demand for high output fuels; this required ratings above that of iso-octane and under supercharge conditions. These requirements meant a deviation from the methods used so far. It was required to evaluate the knock through a fuel-air range met in the aircraft operation for full rich, or take-off mixture. Figure 5 shows how a knock limited power curve looks when plotted against fuel-air ratio at otherwise constant conditions.

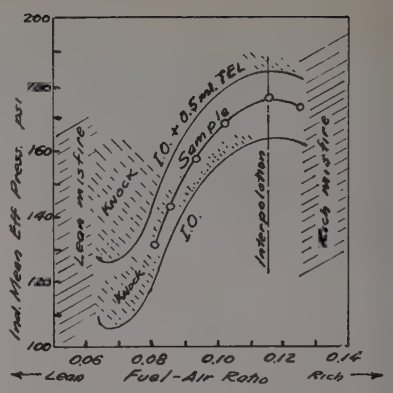


Fig. 5. Shown are knock-limited power curves determined by A. S. T. M. method D909-47T.

In this test, as in the other cases, the basic engine is the Waukesha engine. The induction air is under pressure, which can be varied to simulate supercharged conditions, and thus control the power output. The fuel is injected directly into the induction system. See Table 1. To obtain a rating, the unknown fuel is run into the engine and

(Continued on page 26)

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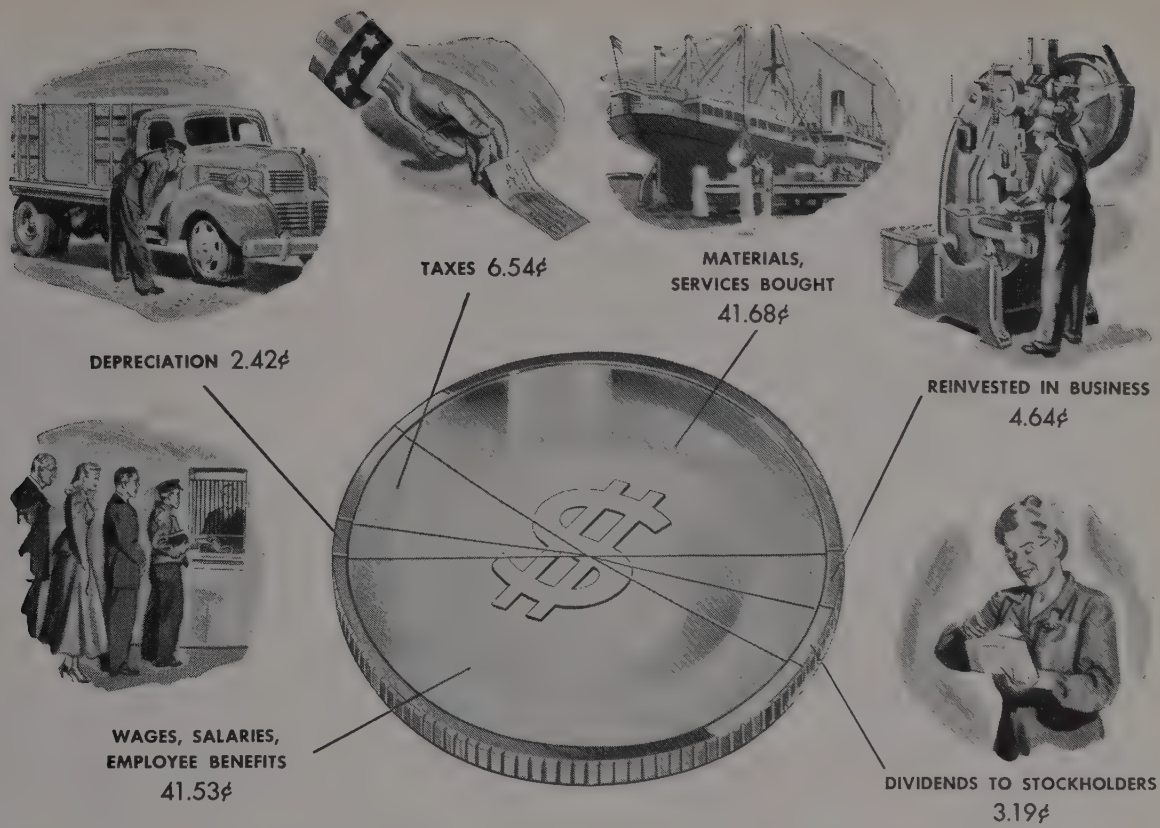


HOW TO DIVIDE UP A DOLLAR

. . . the American Way

It may interest you to know the mistaken notions most folks have about the profits of American companies.

They tell interviewers that they *think* such companies are entitled to make 12 to 15 cents on every dollar of income, as a fair return. Yet, they add, it's their guess that manufacturers *actually do* make about 25 cents!

The facts are that in normal years American companies average about *nine cents* profit per income dollar.

Take Aluminum Company of America in 1947, for example. Out of each dollar received last year by Alcoa and its subsidiaries, the net profit amounted to *less than eight cents*. We show above where the rest of that dollar went. Nearly half of it in wages, salaries, and employee benefits, to Alcoans. Almost another half for materials and services we bought. Over six and a half cents for taxes.

The dollars-and-cents story of Aluminum Company of America represents the kind of facts you'll get from any typical American enterprise. Facts that show a fair return for a good product.

By dividing up a dollar, the American way, Alcoa has provided secure employment for 46,000 aluminum workers and has helped America to gain world leadership in aluminum production and research.

ALCOA

Aluminum Company of America

STEPPING STONES . . .

(Continued from page 24)

the fuel flow is adjusted; the air flow is then adjusted until a reproducible intensity of knock is found at about 0.08 fuel-air ratio. After this point, the fuel flow and air flow are increased, and, maintaining the same intensity of knock, a curve similar to that shown in Figure 5 results. This curve is then bracketed by doing the same with blends of iso-octane and normal heptane, or iso-octane and lead, as the case may demand. The results are interpreted on the basis of the interpolated per cent power value of the test fuel. Iso-octane equals 100%. Data are reported in terms of performance number, which is a power increase rating.

An aircraft fuel designated as grade 100/130 has a lean rating of 100 performance number, or 100% iso-octane, and a rich rating equivalent to 130 performance number, or iso-octane plus 1.30 milliliters of lead. This test is now A.S.T.M. Method D909-47T.

(*Figures 1 and 3 are from "The Science of Petroleum" by Campbell and Boyd* (*Oxford University Press*) *and figures 2, 4, and 5 are by the author, Wallace Hopper.*)

SOCIETIES . . .

(Continued from page 16)

PI TAU SIGMA

Members of Pi Tau Sigma, mechanical engineering honorary fraternity, enjoyed themselves at Latzer hall for their December 8 meeting. This meeting was the semesterly initiation banquet at which 61 pledges and 3 honorary members were pledged and welcomed into the fraternity.

At the business meeting which preceded the initiation, members accepted changes and revisions of the chapter constitution and by-laws. Mr. David Duff, chairman of a committee which will conduct a rating survey of the mechanical engineering department faculty, gave a report on the plans and progress of this committee. Officers for the spring semester who were elected at this meeting were John G. Johnson, president; Harold I. Blotner, vice president; Frederick T. Fariss, secretary; Harold D. Barthel, corresponding secretary; and Charles A. Lessing, treasurer.

Speaker of the evening was Dr. C. F. Hottes, professor emeritus in the department of horticulture at the University of Illinois. In his after dinner speech, Dr. Hottes told of a trip he and eight other scientists made through the uncharted regions along the San Juan and Colorado rivers. He gave a brief history of this section of the country and showed colored movies that he had taken on this trip.

SIGMA TAU

Sigma Tau, all-engineering honorary fraternity, entertained prospective pledges at its December 7 meeting held at Wesley foundation. Professor H. N. Hayward of the electrical engineering department told the guests of the history of Sigma Tau, its purpose, its past activities, and of its future social functions.

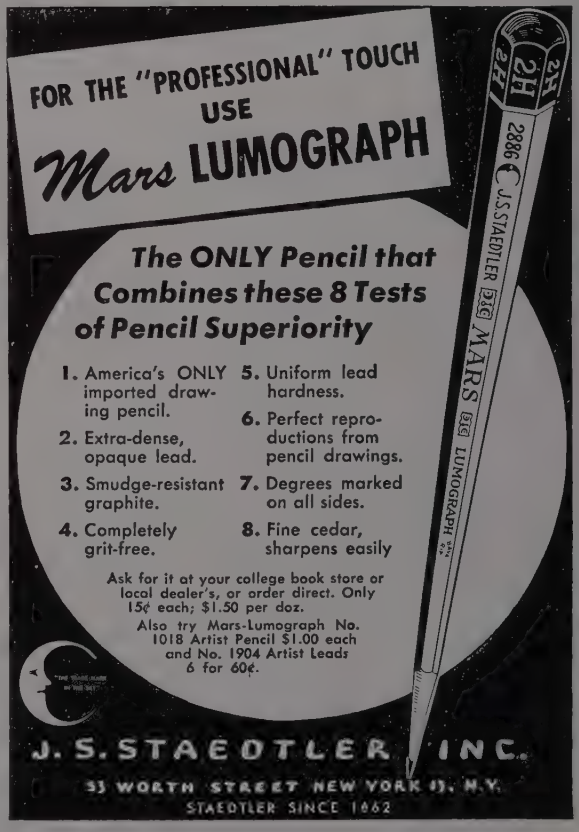
At the December 14 meeting, pledges were chosen. The initiation was at a banquet held in the early part of January.

Professor: "What's your idea of civilization?"

C.E.: "Good idea, someone ought to start it."

* * *

Women blush not in reflection upon what has happened, but in rosy anticipation of what may.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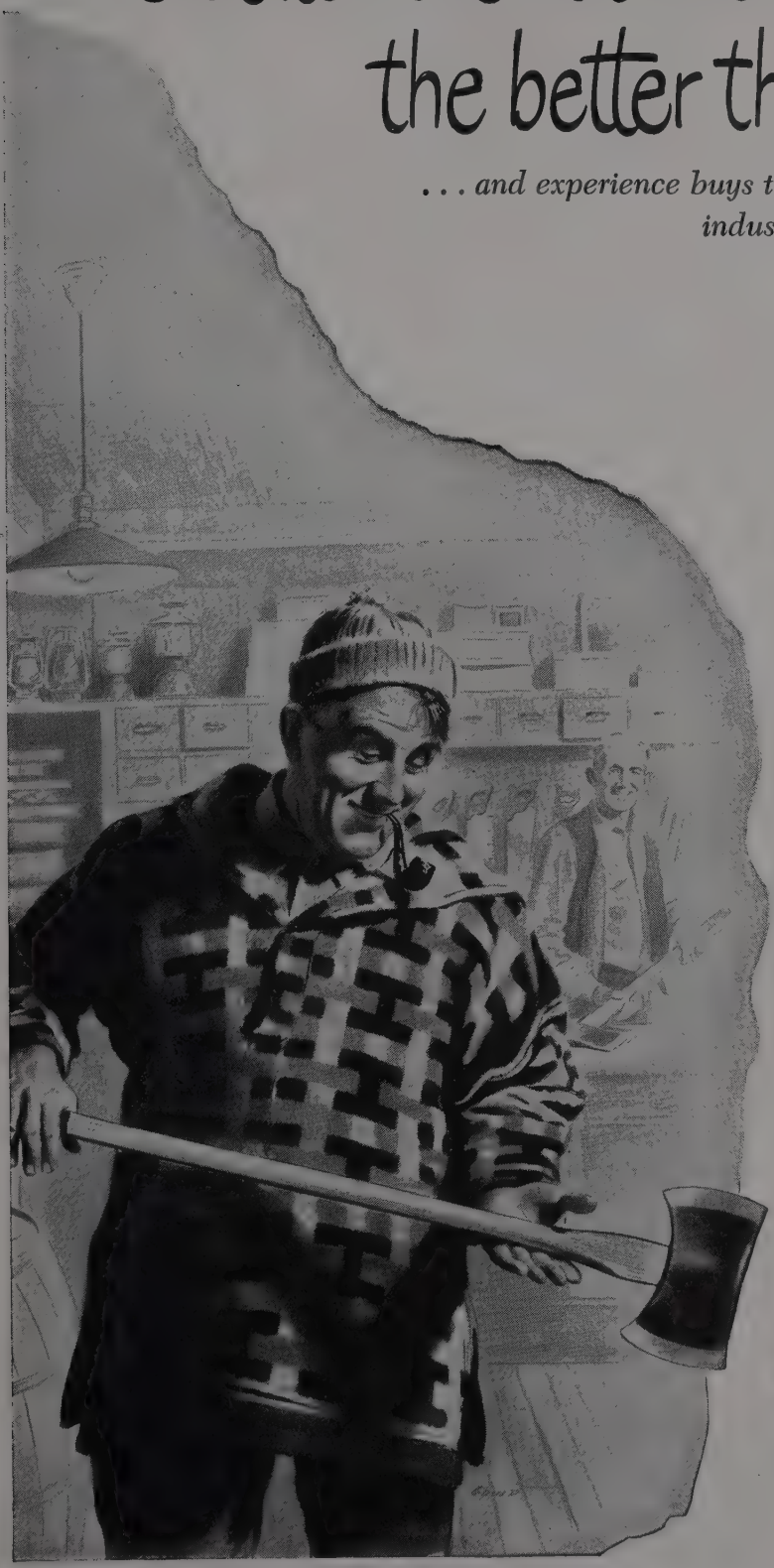

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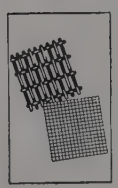

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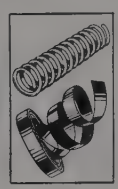

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NAVY PIER . . .

(Continued from page 14)

point, we wish to congratulate our newly appointed editor and wish Sig Deutscher all the luck in the world. It was grand working under Sig, and we are sure that Dick will have his work cut out for him in following Sig.

Pier Engineering Societies

By Bob King, C.E. '51

A.S.M.E.

Approximately 85 per cent of the members were present at the smoker held in November. Mr. Oldacher spoke on the "Importance of the Professional Society," and movies on atomic energy and the Ohio-Illinois football game were shown. Everyone enjoyed the cider and doughnuts, as well as the interesting program.

Bob Beardmore acted as host and presented many novelty dances at the "Turkey Trot," also held in November. Seventy members and guests were present to enjoy the refreshments and dances.

The lecture by Dr. Allison of the University of Chicago, a noted authority in the field of atomic research and nuclear fission, turned out to be a wonderful success. The lecture by Dr. Allison cleared up many false impressions that many of us had about atomic energy, and was most interesting. In the subject, "Nuclear Physics Today," Dr. Allison stressed the importance of radio activity and its uses in industry, pathology, biology, and pharmacy. He also gave a brief history of his research at the Midway laboratories at the University of Chicago and the development of the present cyclotron and problems encountered in its development.

On December 8, a regular meeting was held. A movie, "Fixed Gauges" was shown, and the newly formed engineering council was discussed.

A field trip to the electromotive division of General Motors at LaGrange was held on December 21.

At the Freshman Convocation and at registration in February, the society is planning to operate a booth to familiarize new students with the society. New memberships will also be accepted at that time. The society also plans to hold regular meetings every other week during the spring semester, with speakers and movies alternating for the program. Also, if it is possible, additional programs similar to the lecture by Dr. Allison—which drew a very large crowd —will be scheduled.

The society wishes to extend its full cooperation to the Engineering council, and the societie's chairmen, Mr. Victor E. Swenson, wishes to thank all his fellow officers and the society sponsor, Mr. Cobb, for the excellent and diligent cooperation he has received from them in making the fall semester program successful.

A.S.C.E.

About 100 men and their dates had a good time dancing and playing games at a party and get-together at Keyman's hall on Friday evening, December 3. The party broke up around midinght.

Mr. C. A. Walls, of the Portland Cement corporation, spoke on "Expressways," at the regular meeting held on Monday, December 13.

The society hopes to have a big meeting in January, when an out-of-town speaker will be present.

A.I.E.E.

Thus far this semester, two movies, "Dawn of Better Living," and "Magic of Fluorescence" have been presented. It is planned to have an I.B.M. representative speak at a meeting in January.

At the business meeting held on December 14, the constitution of the A.I.E.E. was drawn up. John Doering has been appointed as Engineering council representative.

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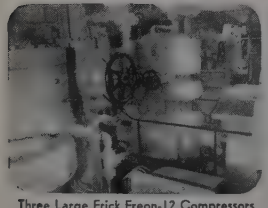

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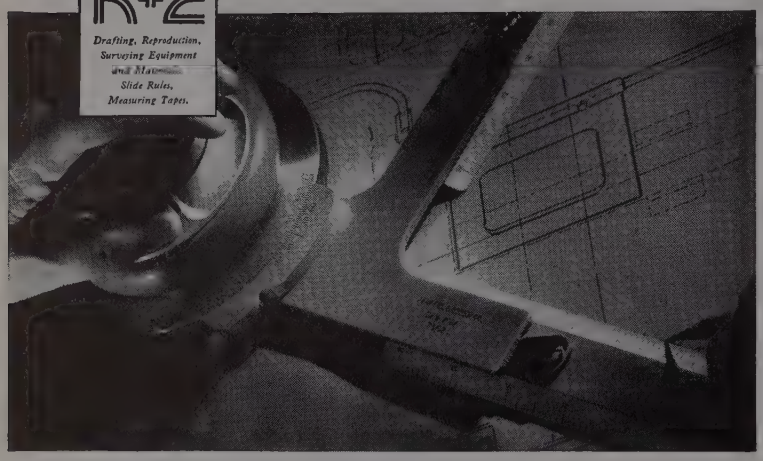

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JETS ARE JUMPING . . .

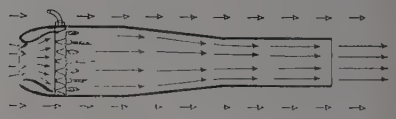
(Continued from page 9)

they use. However, the development of atomic power might remedy this defect.

Pulse Jet

Another jet reaction unit which is not being extensively used is the pulse jet. The pulse jet is composed of a long tube with non-return admission valves at the entrance to the tube. The fuel injection nozzles are located just behind these valves and are directed straight back. Immediately following the injection nozzles are venturi sections through which the fuel enters the combustion chamber. The combustion chamber, which is formed by the tube, narrows down to a tail pipe of smaller diameter.

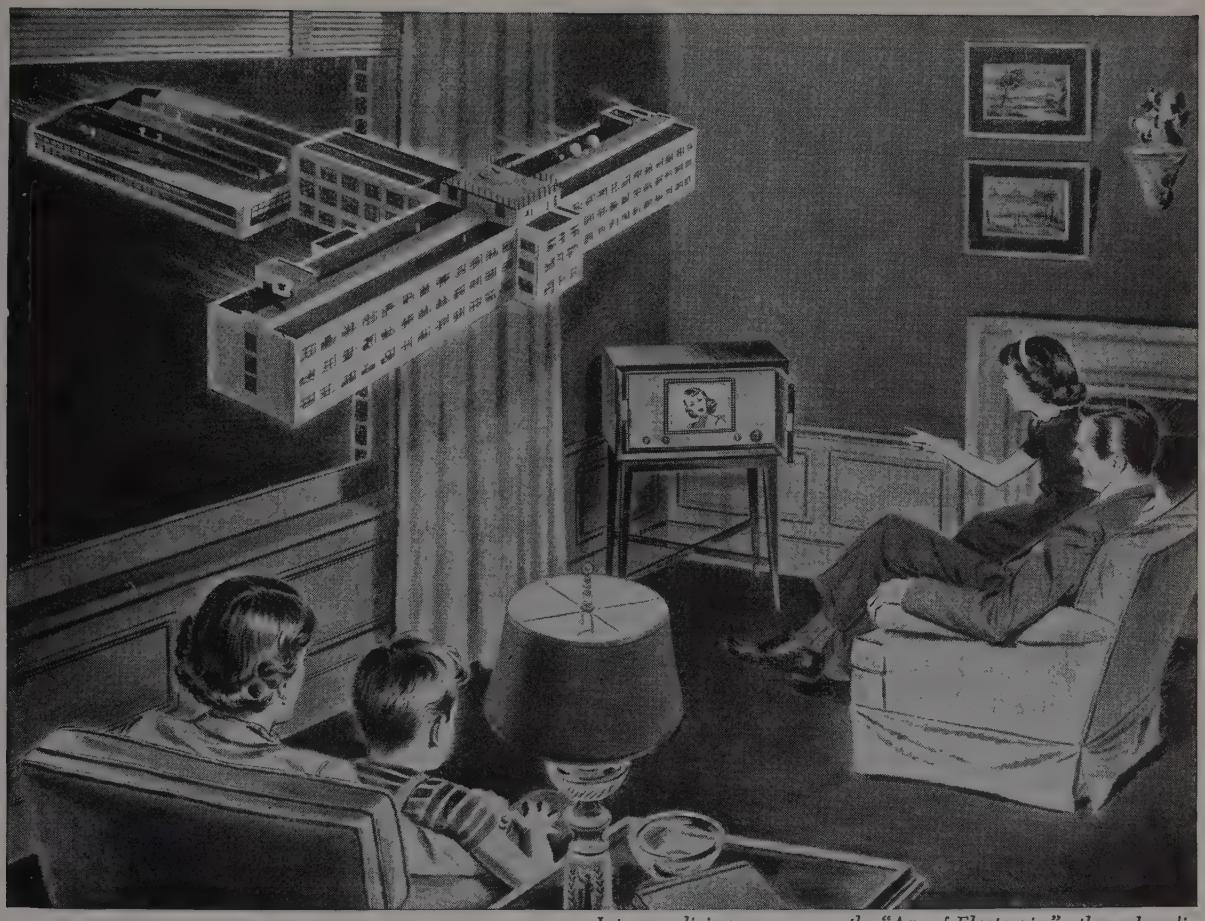
In order to start the pulse jet there must be air pressure against the valves at the nose of the tube. This pressure is supplied either by moving the unit through the air or by shooting compressed air against the front of the tube. The air pressure on the nose opens the valves and air is admitted into the tube. As the air travels to the combustion chamber it is mixed with the fuel, which is injected through the nozzles, and a combustible mixture is formed. Compression is obtained partially by the air itself as it is rammed into the combustion chamber. The rest of the compression is obtained during combustion as a result of the rapidly expanding gas. As soon as the combustible mixture has been rammed into the combustion chamber, it is ignited by a spark plug. The spark plug is needed only for the first explosion, for the operation is continuous thereafter, and the mixture is ignited by the heat formed from the previous explosion. When the mixture is ignited there is a rise in pressure inside of the tube, and the non-return valves at the nose of the tube are closed. The gases then expand out the tail pipe. As the gas rushes out of the tail pipe, the pressure in the combustion chamber drops. As soon as the pressure inside has dropped below that of air pressure on the front of the valves, more air is admitted in, and the process is repeated.



The impulse jet was employed on the German flying bomb.

The phase of operation is repeated in pulses and this is how the unit obtains its name. One of the most difficult achievements in the design of a pulse jet is to obtain correspondence be-

(Continued on page 32)



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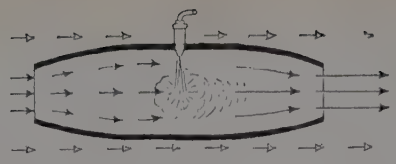
JETS ARE JUMPING . . .

(Continued from page 30)

tween the pulses or vibrational frequency of the valves and the vibrational frequency of the tailpipe. The frequency with which the combustion gases leave the tail pipe depends upon the dimensions of the pipe.

The reaction opposite to that of the gases passing out the tail pipe or tail nozzle of the jet is the jet reaction or jet propulsion which propels the plane.

The pulse jet is used mainly for model airplanes and for guided and unguided missiles. One difficulty of the pulse jet is the large frontal area formed by the valves at the nose of the tube. The impact of the air upon this area imposes a large drag force. The efficiency of the pulse jet falls far below that of the other propulsive units.



The ram jet does not have any moving parts.

Ram Jet

The ram jet is the only air-breathing jet unit which does not have any moving parts. This unit somewhat resembles a stovepipe with a small diameter at each end and a large diameter in the middle. All of the dimensions of a ram jet are dependent upon calculations made by the use of thermodynamic formulas.

The ram jet is composed of three parts: (1) the diffuser, (2) the combustion chamber and, (3) the exit nozzle. The diffuser is located at the front of the jet. It forms a small diameter at

(Continued on page 34)

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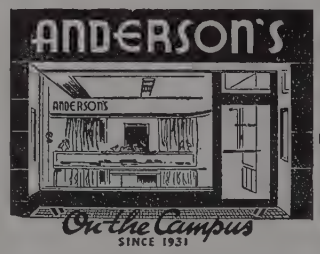

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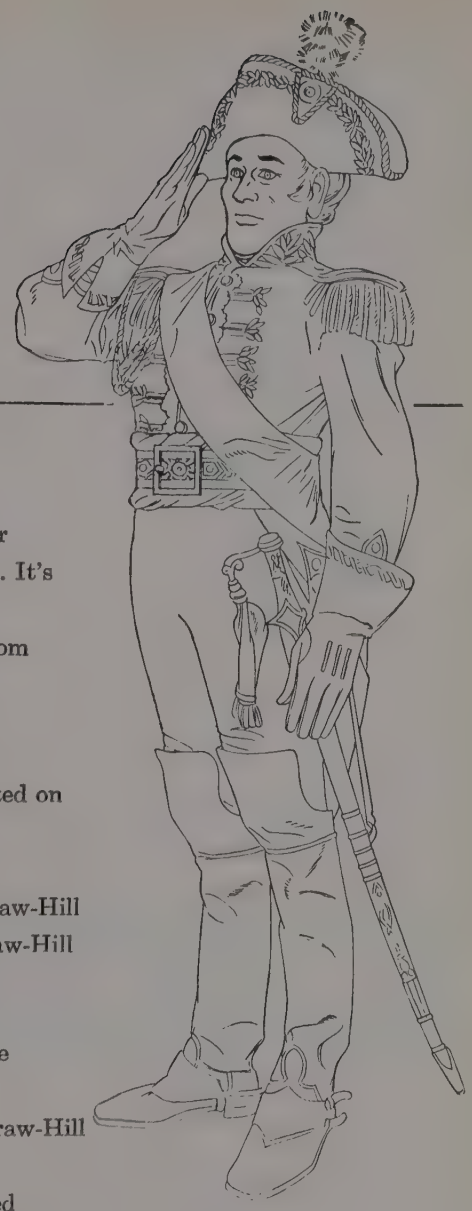

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JETS ARE JUMPING . . .

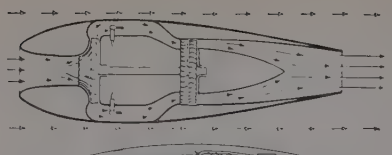
(Continued from page 32)

the nose and tapers into the larger diameter of the combustion chamber. The combustion chamber then tapers down to form the tail pipe and exit nozzle.

The air enters the ram jet through the small diameter at the nose of the diffuser. As the air passes along the diffuser the diameter becomes larger, and thus the area increases. This increase in area causes the velocity to decrease and the pressure to rise. The rise in pressure gives the unit its compression. As the air enters the combustion chamber, it is mixed with fuel to form a combustible mixture. The initial ignition is caused by a spark plug, but the operation thereafter is continuous, and the ignition is brought about by the heat of the previous explosion.

The ram jet cannot produce static thrust. It has to obtain a very high speed before it will operate as a propulsive unit. For small units this speed is around 200 miles per hour and for large units around 400 miles per hour. The explanation for this is that the ram jet cannot produce enough thrust to overcome the internal drag until it has reached this speed.

The ram jet's most promising use at the present is in the field of helicopters. The jet units are placed on the tips of the blades and their propulsive power is used to rotate the blades. The ram jet will operate very successfully in this capacity since the top speeds range from 400 to 500 miles per hour. The ram jet also offers promising results as a supersonic propulsive unit, but this requires a slightly different design of the exit nozzle.



The radial flow turbo jet (above) and the axial flow turbo jet (below) mechanically compress the entering air.

Turbo Jet

The jet unit which is being used to operate all of the current jet airplanes is the turbo jet. The turbo jet has proved to be the only practical unit for the present type of aircraft.

The turbo jet is divided into two classes. The distinction is made in the type of compressor which is used. One type uses a centrifugal or radial flow compressor and the other type uses an axial flow compressor. All of the German turbo jet units employed axial flow compressors, and at the beginning, all of the American and British turbo jet units were constructed with radial flow compressors. However, the Americans and British have now developed a number of axial flow compressors also.

The compressor, whether it is axial or radial flow, is located at the nose of the turbo jet. The combustion chambers are placed behind the compressor. Directly to the rear of the combustion chamber is an axial flow turbine. The turbine and compressor are connected on a common shaft. The bullet and exit nozzle are located behind the turbine. The bullet can be moved in and out and is used to vary the exit area.

The turbo jet is started by mechanically turning the main shaft. The jet airplanes are equipped with electric starters which spin the shaft at about one-eighth of the operating speed. As soon as the shaft starts to rotate, the compressor forces air into the combus-

(Continued on page 36)

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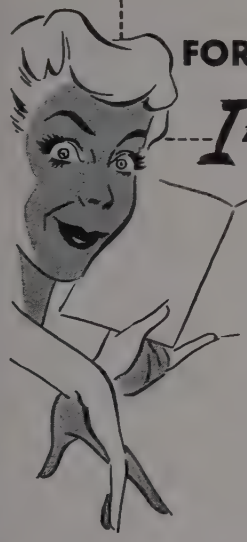

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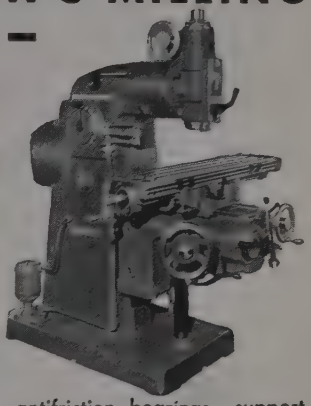

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REFRACTORIES — POROUS MEDIUMS — NON-SLIP FLOORS — NORBIDE PRODUCTS
LABELING MACHINES (BEHR-MANNING DIVISION: COATED ABRASIVES AND SHARPENING STONES)

JETS ARE JUMPING . . .

(Continued from page 34)

tion chamber. The fuel is injected into the combustion chamber and forms a combustible mixture with the compressed air. Since the process of combustion is a continuous one, the spark plug is needed only for the initial ignition. In most turbo jets the spark plug is placed in only one of the combustion chambers and the flame of the initial explosion travels to the other chambers through inter-connecting pipes. After the explosion, the gas is expanded through the turbine. However, only part of the energy is used to turn the turbine; the rest of the energy is expelled as the gas expands through the rear nozzle. As soon as the operation of combustion has begun, the electric motor is turned off and the turbine is used to turn the compressor.

The biggest advantage which the jet engine has over the reciprocating engine is speed. However, the jet reaction engine has many other advantages which place it in such high favor. Listed below are a few advantages of the turbo jet engines compared to the reciprocating engine:

1. No warmup time is needed for the turbo jet.
2. The turbo jet can be designed and produced in about one-quarter of the time that it takes to test a piston engine.
3. Vibration is eliminated since the turbo unit is composed of only rotating parts.
4. There is no sliding friction and no heavy bearings to be lubricated.
5. The absence of an air screw permits a low undercarriage and therefore, a light landing gear.
6. The jet propelled aircraft offer better vision and less restriction for armament.
7. Jet fuels are easier to get and are less expensive.

Although the jet airplane was not developed until recently, there are a large number of different designs in production today.

As time follows time and man gathers new knowledge, startling and revolutionary creations will be produced in the field of aeronautics. However, the advent of these new products will represent the labor, learning, and knowledge which is being endowed upon the aircraft of today.

Bob: "That was a close call, old man. Don't you know you always ought to give a woman driver half the road?"

Bill: "Well, I always try to, as soon as I find out which half she wants."

DU PONT Digest
For Students of Science and Engineering

The story of A CHEMICAL ACHIEVEMENT

How Du Pont scientists found a way to Moistureproof Cellophane

There's no secret to Du Pont's successful system for making chemical discoveries. It is simply research through teamwork.

As each new problem in research arises, it is tackled by men and women whose training and skill qualify them to master it. Backed by ample funds and facilities, they are continuously extending the field of scientific knowledge.

Take the case of moistureproof Cellophane. Plain, transparent Cellophane was strong, clear and protective. As a packaging material it had eye appeal. Its uses were limited, however. Perishable foods wrapped in this cellulose film were protected from contamination and were good to look at, but they did not retain their freshness. They either lost or absorbed moisture, depending on the nature of the food and atmospheric conditions.

That was a challenge to Du Pont research people. They set out to find materials that would moistureproof Cellophane without materially affecting its thinness or transparency. After developing a basic test to measure moistureproofness, they tried various procedures—adding ingredients to Cellophane dope before casting, impregnating sheets in baths and coating the film.

Dr. Hale Charch, *Ph.D., Ohio State '23, reenacts discovery of moistureproof Cellophane film. Bag at far right held water for weeks; other control bags showed evaporation.*

Coating showed the most promise. Had you been a member of the research team on this job, you might have helped mix and test several hundred different coating formulae over a 10 months' period. With successful coatings in sight, a small pilot operation was set up. Then—to make sure the new Cellophane was right—doughnuts, cookies and cakes were wrapped in it and sent to market. Finally, engineers were called on to design machinery for full-scale operation.

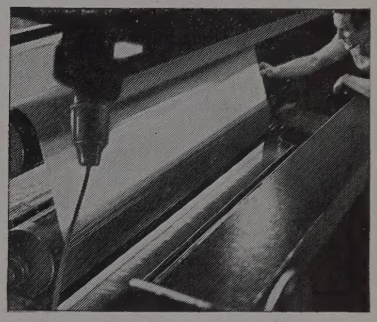
Now everything from chewing gum to porterhouse steaks is being sold in moistureproof Cellophane. Another scientific achievement is helping change the food packaging and food buying habits of America!

Using your training at Du Pont

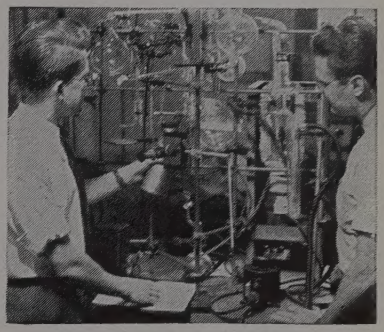
Diverse problems call for diversified talents. At any one time, there are hundreds of interesting projects under way in the Du Pont laboratories. You may be trained in chemistry, engineering or physics. You may have studied in the fields of botany, entomology, parisitology, pharmacology or plant pathology. In fact, almost all the sciences are put to use at Du Pont.

Working as a member of a small team, the individual is afforded every opportunity to show his talent and capabilities.

Cellophane has become *the nation's symbol for modern packaging. Since 1927, continuing research has developed over fifty different types.*

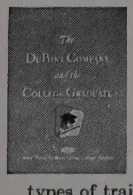


Cellophane is made *by extruding viscose through a slit into an acid bath where it coagulates into sheets. Moistureproofing follows.*



Organic Chemist M. L. Ward, *Ph.D., Illinois '42, and Physical Chemist P. E. Rouse, Jr., Ph.D., Illinois '41, conducting research on the permeability of thin membranes, including Cellophane.*

This is a booklet you shouldn't miss



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WRITE TODAY *for "The Du Pont Company and the College Graduate"*

GALESBURG . . .

(Continued from page 15)

The Navy leased a building on the Galesburg campus containing approximately 2,800 square feet of floor space to house all the equipment and facilities necessary for training electrical technicians. This building will house equipment representing a total value of over $100,000, when the remainder of the equipment is received from the Navy.

The volunteer unit has an authorized complement of five officers and 40 men under the command of Comdr. M. J. Galbraith, U.S.N.R., who is the director of student welfare at the Galesburg division. The unit's executive officer is Lt. Comdr. De Voss, U.S.N.R., a resident of Galesburg. Dr. H. L. Lawder, commmander, U.S.N.R., is the company's medical officer, and Lt. Comdr. H. C. Woolsey, U.S.N.R., is communications officer.

The specific purpose of the Electronics Warfare unit is to keep the naval reservists up-to-date and familiar with the most recent developments in the field of electronics. The program is designed to provide former navy personnel with up-to-date information on the repair, maintenance and operation of radio transmitters and receivers, radar gear, direction finders, and all types of electronic equipment. In addition, the program provides for the training of new recruits in the Naval Reserve who are interested in the field of electronics.

The recruit who has had no previous experience is taught the basic principles of electricity. The trainee progresses through the various phases of radio transmission and reception of code, and learns the repair and maintenance of electronics equipment.

The training and re-orientation program follows as closely as possible the procedure used in the regular Navy training schools. Naval Reserve officers and enlisted men who have had considerable training and valuable experience instruct the trainees in the various specialized fields of electronics.

The unit meets regularly twice a month for the purpose of training. Lectures on the various phases of study are given during the first part of the period. The latter part of the period is devoted to the practical applications of the principles presented in the lectures. The electronics laboratory is a great aid to the trainee because he can actually see and put into practice the subject matter covered in the lecture period.

The Naval Reserve student who applies himself may receive advancement in grade after he has completed the requirements specified by the Navy, provided the commanding officer and his instructors have deemed his progress satisfactory.

To Naval Reserve members of all branches and to new recruits in the reserve, the Naval Reserve Electronics Warfare unit offers excellent opportunities to learn a trade in a relatively new and very improtant field. The training of qualified technicians and repairmen by the unit at Galesburg, and the many other units throughout the United States will result in better job opportunities for many of those who could not otherwise secure this specialized training. In addition, the program will create a large reserve force of technicians who are able to take over important duties in case of a national emergency.

The Galesburg division of the University of Illinois is fortunate in having such a unit on the campus. The physics and engineering department may use the equipment and laboratory at the discretion and supervision of the commanding officer. At the present time about 90 per cent of the complement consists of division students, mostly engineers, with the remainder consisting of reservists from the Galesburg area.

Answers to Vocabulary Quiz

1-b, 2-b, 3-c, 4-b, 5-b, 6-d, 7-b, 8-b, 9-c, 10-c, 11-d, 12-b, 13-c, 14-b, 15-a.

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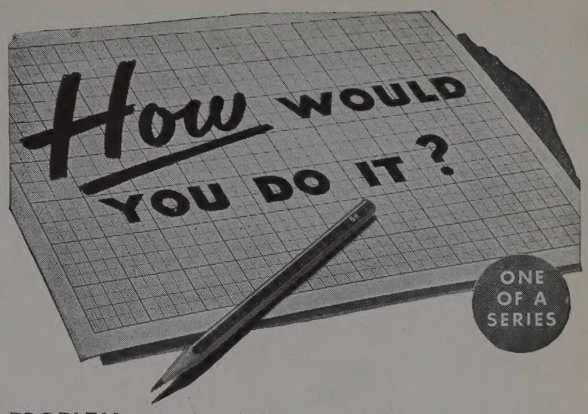

PROBLEM—You're designing a radio broadcast transmitter. The circuit includes condensers and other variable elements which must be adjusted by the operator. You want to place these elements for optimum circuit efficiency and where they will be easy to assembly, wire, and service. At the same time, you want to centralize the control knobs at a point convenient to the operator. How would you do it?

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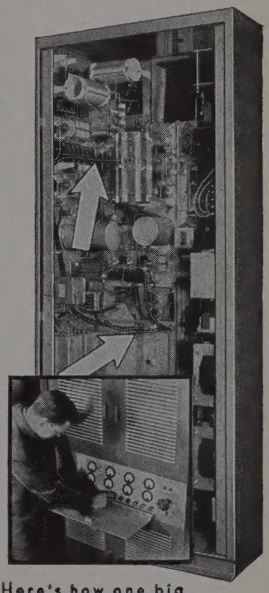

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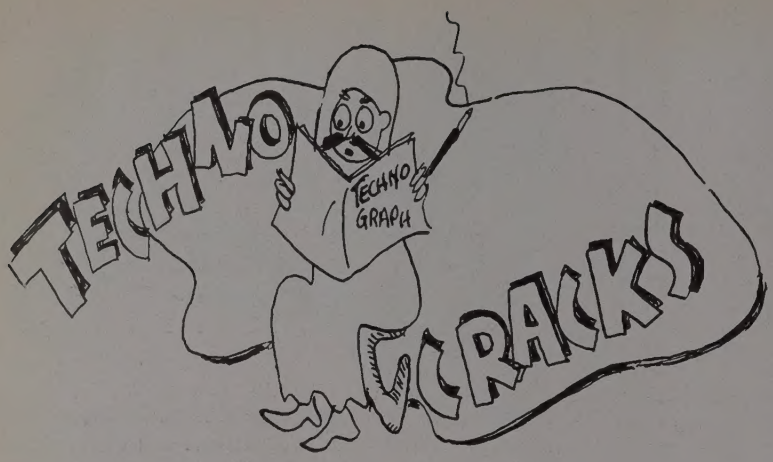

—Well, Sam, I see you're back for fighting with your wife. Liquor again?"

—"No sah, Jedge, she licked me dis time."

* * *

She: "I want a lipstick."
Clerk: "What size, please?"
She: "Three rides and a house party."

* * *

"Is your wife having any success in learning to drive a car?"

"Well, the road is beginning to turn when she does."

* * *

As one little electron said to another when they met in a new element: "I don't know you from atom."

* * *

"You know, you're not a bad-looking girl."

"Oh, you'd say that even if you didn't think so."

"We're even then. You'd think so even if I didn't say so."

* * *

He: I've got to get rid of our chauffer; he's nearly killed me four times.

She: Oh, give him another chance.

* * *

Floridian (picking up melon): "Is this the largest apple you can grow in your state?"

Californian: "Stop fingering that grape."

* * *

Pop: "Well, I received a note from your teacher today."

Son: "Honest, Pop? Give me a quarter and I won't breath a word about it."

* * *

"Good morning, Mrs. Kelley," said the doctor, "did you take your husband's temperature as I instructed?"

"Yes, doctor, I borrowed a barometer and placed it on his chest. It said 'very dry,' so I bought him a pint of beer and he's gone back to work."

The following took place in the reading room of our library:

A coed was reading birth and death statistics. Suddenly she turned to a male on her right and said, "Do you know that every time I breathe a man dies?"

"Very interesting," said he, "why don't you try Sen-Sen?"

* * *

Young Wife: "Would you be surprised if I gave you a fifty dollar check for your birthday, darling?"

Husband: "Yes, sweet, I would."

Y.W.: "Well, here it is, all made out ready for you to sign."

Lady: "Have you ever been offered work?"

Tramp: "Only once, madam. Aside from that I've met with nothing that kindness."

* * *

—"What are the young man's intentions, daughter?"

—"Well, he's been keeping me pretty much in the dark."

* * *

Hyde—Were you lucky at the race track yesterday?

Wyde—I'll say I was! I found a dime after the last race, so I didn't have to walk home.

* * *

She (spurning suitor)—"I wouldn't leave my happy home for any man."

He (brightly)—"All right, we'll live here."

* * *

1st Coed: "That boy you were riding with has trouble with his vision?"

2nd Coed: "Yes, he sees parking spots before his eyes."

* * *

Woman on crowded bus: "I wish that good looking man would give me his seat."

Five engineers got up.

* * *

Mary had a little car
She drove in manner deft
But every time she signalled right
The little car turned left.

VOCABULARY CLINIC

Remember, you won't be able to use these words until after you have consulted the dictionary for their pronunciation. From the group of words at the right, select one whose meaning most closely resembles the word on the left. Answers will be found on page 38.

1. Welter—(a) prize fighter, (b) turmoil, (c) North Atlantic fish, (d) sultry heat
2. Putative—(a) quarrelsome, (b) reputed, (c) arithmetical, (d) cruel
3. Semantics—(a) an Asiatic race, (b) empty talk, (c) science of meanings, (d) division of biology
4. Hiatus—(a) Japanese musical instrument, (b) an opening, (c) a pretentious person, (d) legislative bill
5. Anomalous—(a) similar to, (b) exceptional, (c) pertaining to a goose, (d) dramatic
6. Puissant—(a) cat-like, (b) cowardly, (c) insignificant, (d) powerful
7. Epicene—(a) African antelope, (b) sexless, (c) sensual, (d) glutton
8. Matutinal—(a) mother-like, (b) pertaining to the morning, (c) tasty, (d) musical
9. Cognizant—(a) mechanical, (b) lustrous, (c) sensible, (d) surly
10. Mitigate—(a) to cut into four parts, (b) to travel, (c) to make milder, (d) to pick a quarrel
11. Inchoate—(a) improper, (b) polished, (c) penniless, (d) recently begun
12. Prescience—(a) introductory course in science, (b) foreknowledge, (c) authorization, (d) warning
13. Scintillate—(a) to destroy, (b) to break the Ten Commandments, (c) to glitter, (d) to go away
14. Overt—(a) dishonest, (b) apparent, (c) to prevent, (d) to overlook
15. Pragmatic—(a) opinionated, (d) citizen of Prague, (c) influential, (d) uncultured